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	480,710	519,423
	1,403,690	1,553,417
INCOME	477,255	528,162
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INCOME		

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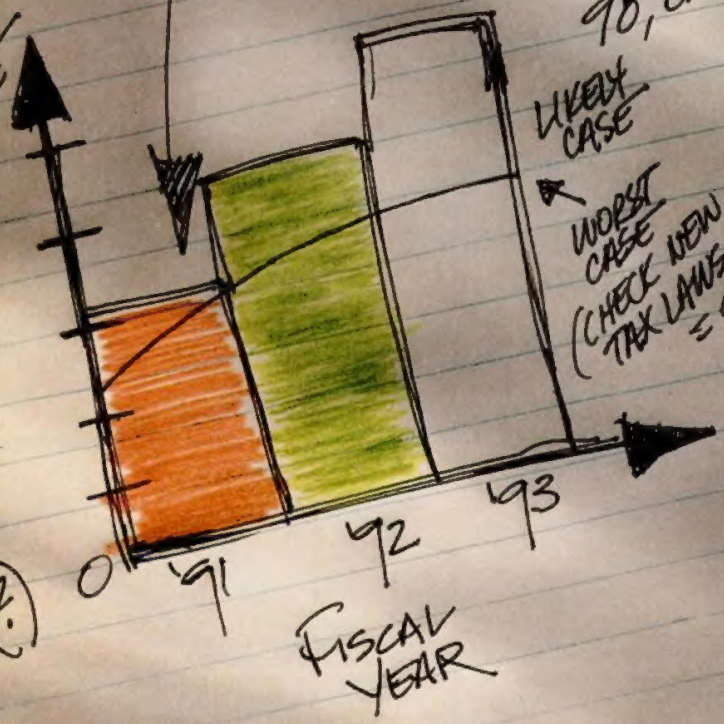
98,82

84,866
8,162

56,



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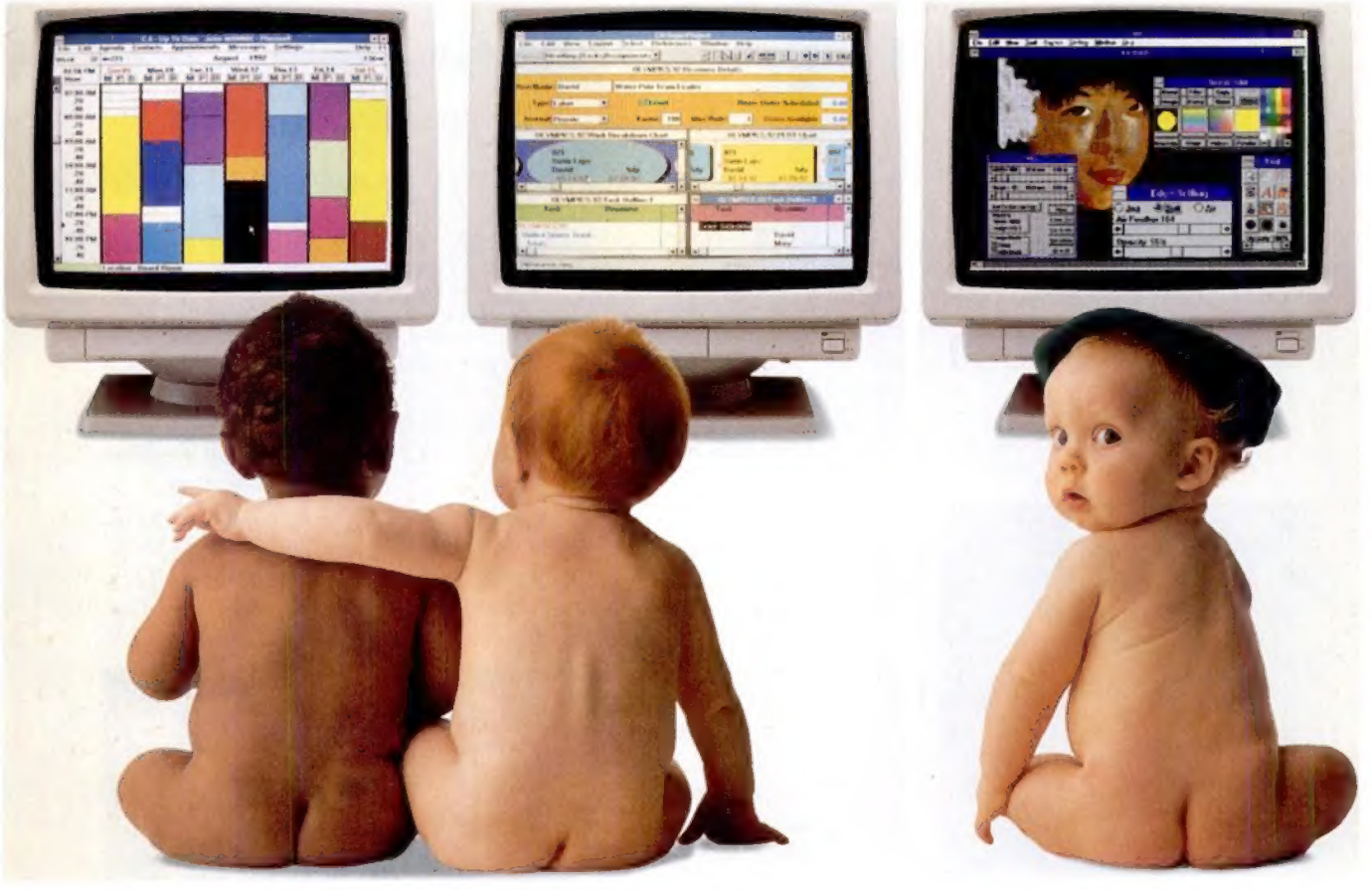

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Inside

The PC Magazine Labs benchmark tests have long been the standard for measuring PC performance. But in an industry that changes as quickly as the computer business does, we can't afford to be complacent. The 65 laptops in this issue have been tested using our latest and best version of the benchmark tests.

"Version 7.0 adds many enhancements to our tests of processor, memory, video, and disk subsystems," says Nick Stam, technical director for hardware at PC Magazine Labs. The Windows portion of the tests now includes a measure of disk performance under Windows and extensive revisions of the Graphics Winmark test.

Our new tests address the impact of internal caches, as well as second-level caches and memory subsystems. Also, the new tests closely emulate the kinds of calls and operations that standard applications use, giving you a more accurate picture of how a particular system will perform while doing real work. We used the new tests for the first time in preparing the feature story on upgradable PCs that appeared in our issue of November 24, 1992. For a complete technical discussion of the tests, see Stam's Lab Notes in that issue.

Stam and PC Labs director James Galley began planning the revisions of our benchmark tests a year ago. They recruited expertise throughout the Ziff-Davis family to complete this mammoth task on time. ZD Labs' technical director Robert Kane and staffers Michael Agerbak and Thomas Siering pitched in. So did Ed Henning—the director of PC Labs UK—and *PC Magazine* programmers Stuart Greenberg and Bradley Epranian. Consultant Ben Meyers reworked the Windows graphics routines.

Staffers who helped update PC Magazine Labs' benchmark tests include (from left): Epranian, Galley, Kane, Greenberg, Stam (front), Henning, Siering, and Agerbak.

Copies of PC Labs' Hardware Benchmark Tests, Release 7.0, are available in the free section of our PC MagNet forum on CompuServe, or you can write to Benchmark Tests, *PC Magazine*, One Park Ave., New York, NY 10016.—*Joel Dreyfuss*

PC Magazine: The Independent Guide to Personal Computing, ISSN #0888-8507 is published biweekly except in July and August for $44.97 for one year. Ziff-Davis Publishing Co., a division of Ziff Communications Co., One Park Ave., New York, NY 10016. Second-class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Address changes to **PC Magazine,** P.O. Box 54093, Boulder, CO 80321-4093.

Photograph by Peter Gregoire

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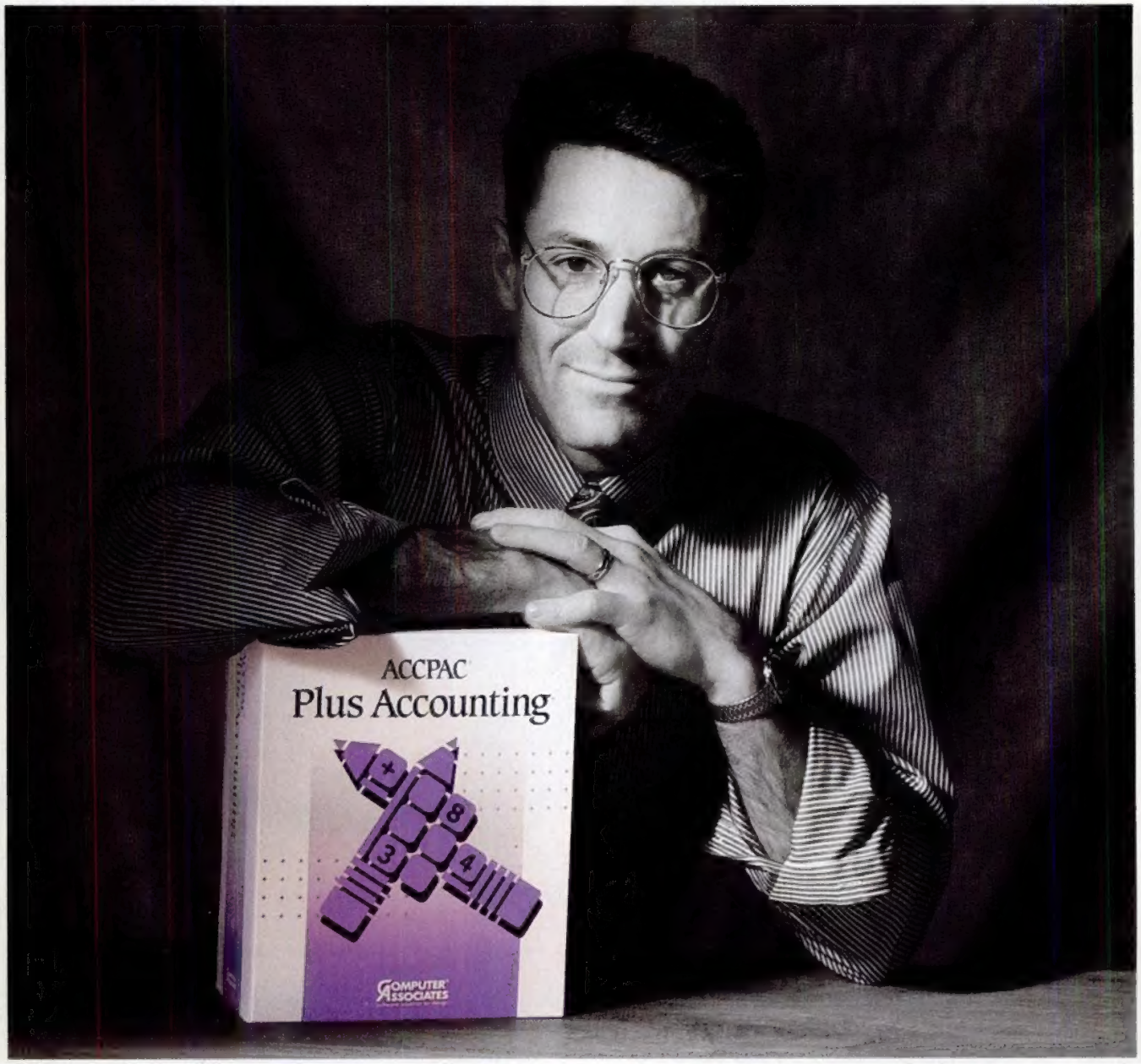

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CIRCLE 389 ON READER SERVICE CARD

PC MAGAZINE December 22, 1992 Volume 11 Number 22

UP FRONT

Inside
Our new benchmark tests .. 4

Letters
According to our readers, DOS lives! 19

Trends
- Intel's low-voltage 486SL
- Faster Windows printing
- All-in-one peripherals
- Electronic democracy? .. 29

First Looks
- Pacific Data ProTracer
- Microsoft Money 2.0
- American Heritage Electronic Dictionary 37

New & Improved
BY E. ANDREW TORGAN 58

Read Only
EDITED BY CAROL LEVIN 69

Toolkits
EDITED BY TRUDY NEUHAUS 75

COLUMNISTS

Michael J. Miller
Two Paths Diverged 79

Bill Machrone
The OS/2 Game Plan 85

John C. Dvorak
Screwball Sales Gimmicks ... 91
Inside Track 93

Jim Seymour
The Little Things Mean a Lot 97

William F. Zachmann
Parting Predictions 103

COVER STORY

Technical Excellence

9th Annual Awards for Technical Excellence

BY MICHAEL J. MILLER Once again our annual awards affirm that innovation and ingenuity are alive and well in the computer industry **108**

Standards/Hardware 110	Peripherals 124	Graphics Applications 141
Operating Systems and Software Standards 111	Components/Subsystems 126	After Hours 142
Portable Systems 112	Development Tools 130	Person of the Year 144
Systems 122	Networking/ Communications 132	Lifetime Achievement 144
Printers 123	Applications 136	

FEATURES

Computers

Portable Computers: On the Road

BY BILL HOWARD Slim, light, and powerful are the qualities that traveling executives cherish most in a portable computer. *PC Magazine* tests 62 of the latest monochrome notebooks and subnotebooks to see which are the most appropriate for computing on the go **153**

AcerAnyWare V386SL 159	*Compaq Contura 3/25* 216	*PC&C Dynova SLic3000* 246
ALR Ranger M425s-120 162	*Compaq LTE Lite/25E* 217	*Poly NB325T* 246
ALR Ranger MC425s-120 162	*CompuAdd Express 425CXL-80* 217	*Poly NBC25* 248
ALR Ranger M425-120 162	*Dell Dimension NL20* 218	*Primax Eagle 425SX* 248
ALR Ranger MC425-120 162	*Dell System 320SLi* 219	*Primax NightHawk 325SXL* 250
Altima 325 80386SL 172	*Dell System 325N* 222	*QSI Klonimus Lite 386SL/25* 250
Altima 433 80486DX 172	*DECpc 325P* 222	*Samsung NoteMaster 386L/25* 256
Compudyne Slimnote 386SL/25-80 172	*GRiD 1660* 222	*Tandy 3800 HD* 258
Compudyne Slimnote 486SX/25-80 172	*GRiD 1755 486SLC* 222	*TI TravelMate 4000 Win SX/25 and WinDX/25* 258
Lightning Thundernote 486DX/33 172	*DTK Grafika 3N* 225	*Toshiba Satellite T1800* 259
Twinhead Slimnote 486DX/33 172	*Everex Carrier SL/25* 226	*Toshiba T3300SL* 260
American Mitac 3025F 189	*GRiD Convertible* 226	*Wyse DecisionMate 486SLC* 261
American Mitac 3027F 189	*IBM PS/note N45sl* 229	*ZDS Z-Note 320Lb* 263
Amrel MLT486DXU33 189	*Identity 386SXL-25 Notebook Computer* 230	*ZDS Z-Note 320L* 263
Aspen Aquiline 433 198	*Jetta Jetbook 486DX/33* 230	*ZDS Z-Note 325L* 263
Ergo 486DX-33 NoteBrick II 198	*Keynote 386SX-25* 237	*ZDS Z-Sport 325S* 264
Austin 386/SXL-25 Notebook 199	*Keynote 486SLC* 237	Highlights 155
AVI ANB3-386SXL-25 199	*Leading Edge N3/SL25 Plus* 238	Editors' Choice 158
BLK 386SL/25 NBF 215	*Librex T386SX* 238	Battery Life vs. Portability .. 170
Chaplet 386 SL25 Notebook 215	*Librex R386SL* 240	Performance Tests 177
Compaq Contura 3/20 216	*Matrix 486SX-25MHz Notebook* 240	Summary of Features 200
	Mitsuba Ninja 486SX 244	Service & Reliability 223
	Micro Express NP933 244	
	Micro Express NB 486DX ... 244	

Photography by Ralph Masullo

PC MAGAZINE December 22, 1992 Volume 11 Number 22

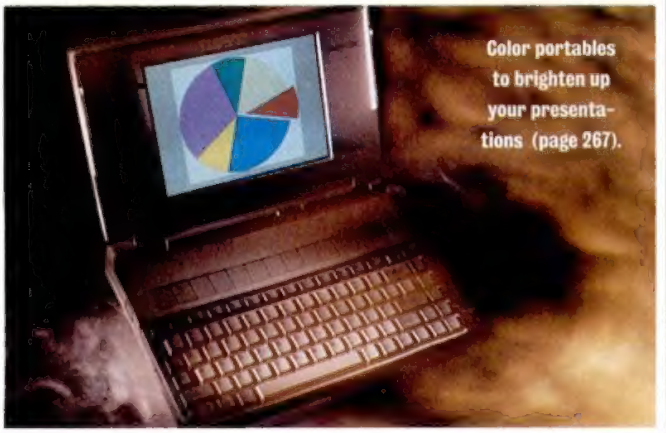
FEATURES

Computers

Recasting Color in a New Light

BY BILL HOWARD The advent of high-quality passive-matrix screens has brought color portables within the reach of most business budgets. *PC Magazine* reviews the six most recent additions to the rich palette of recent laptops 267

Compaq LTE Lite/25c 268	Highlights 268
Keydata Color Keynote 386SL-25 269	Editors' Choice 269
Toshiba T4400SXC 279	Suitability to Task 270
ZDS Z-Note 325Lc Model 120 290	Price/Performance Index ... 279
Zeos Color Notebook 291	Summary of Features 281



Color portables to brighten up your presentations (page 267).

Hardware

CD-ROM Drives: Mass Appeal

BY JOHN R. QUAIN As an inexpensive medium for the mass distribution of information, CD-ROM drives can't be beat. Falling prices (as low as $300 list) and rising transfer rates (up to 300 KBps) characterize offerings among the 22 products we review here 293

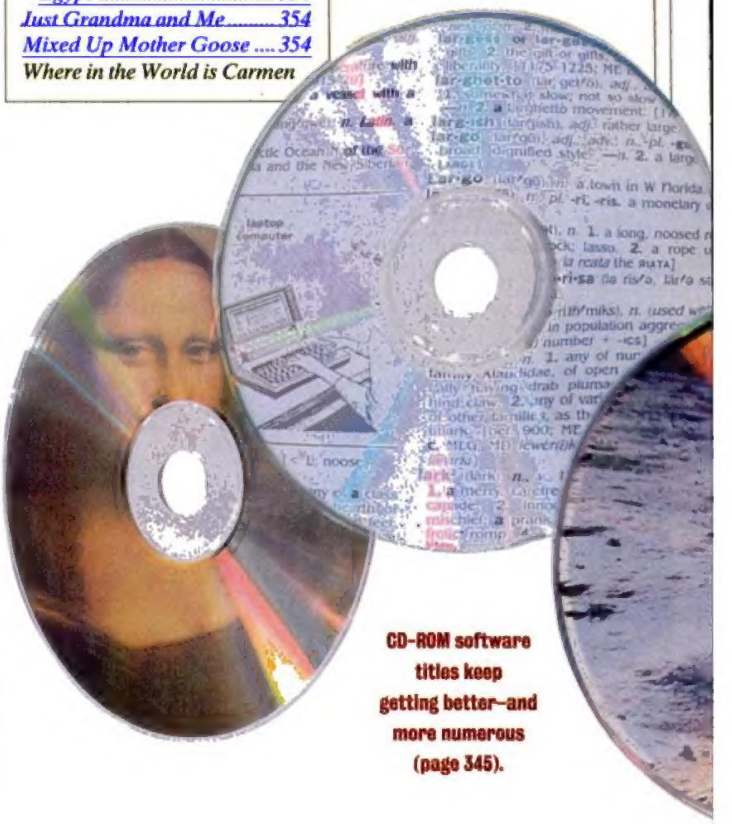
CD Porta-Drive Model T3301 308	*Sony CDU-31A-02* 333
Chinon CDC-435 310	*Sony CDU-7211* 333
Hitachi CDR-3700 312	*Storage Devices SCD-683* ... 337
Hitachi CDR-3750 312	*Tandy CDR-1100* 338
LMS CM225 316	*Texel DM-5024* 340
Liberty 115 Series CD-ROM 317	*Todd TCDR 7000* 343
MacProducts Magic CDR74 325	*Todd TCDR 7050* 343
MacProducts Magic 3301 Toshiba 325	Highlights: CD-ROM Drives 294
NEC InterSect CDR-37 328	Editors' Choice 303
NEC InterSect CDR-74 328	Performance Tests 310
Philips CM-205XRS 330	Desktop CD-ROM Recorders: The In-House Recording Solution 317
PLI CD-ROM Drive 330	CD-ROM Drives: Doubling Throughput 333
Procom PXCDL 332	Summary of Features 334
Procom SXCDS-C8 332	

Software

27 Good Reasons to Buy a CD- ROM Player

BY ROBIN RASKIN The number of CD-ROM software titles grows exponentially. We've searched and sifted to give you our best picks in the reference, entertainment, and educational arenas 345

Software Toolworks World Atlas MPC 347	*Sandiego?* 354
Street Atlas USA 347	*Battle Chess Enhanced CD-ROM* 356
Macmillan Dictionary for Children 348	*King's Quest V* 356
The Oxford English Dictionary on Compact Disc 348	*Sherlock Holmes: Consulting Detective* 356
Compton's MultiMedia Encyclopedia for Windows 348	*Berlitz: Think & Talk French* 356
New Grolier Multimedia Encyclopedia 349	*Cinemania* 357
Great Literature Personal Library Series 349	*Composer Quest* 357
Great Wonders of the World .. 349	*Multimedia Beethoven: The Ninth Symphony* 357
1991 TIME Magazine Compact Almanac 352	*Renaissance Masters I* 369
McGraw Hill Science and Technical Reference Set ... 352	*Variety's Video Directory Plus* 369
Microsoft Bookshelf 352	*Distant Suns* 369
Vital Signs: The Good Health Resource 352	*Mammals: A Multimedia Encyclopedia* 369
Annabel's Dream of Ancient Egypt 354	Coming Attractions 349
Just Grandma and Me 354	For More Information 357
Mixed Up Mother Goose 354	Special Foldout: A Complete Listing of CD-ROMs 359
Where in the World is Carmen	



CD-ROM software titles keep getting better—and more numerous (page 345).

PC MAGNET—Available on PC MagNet.

TECHNICAL COLUMNS

User-to-User

PC MAGNET BY NEIL J. RUBENKING Try out the Dvorak keyboard layout using this tiny utility program; learn some tricks that will enhance your use of DOSKEY macros 371

Tutor

PC MAGNET BY JEFF PROSISE Locking and Unlocking Your Hard Disk . 373

Utilities

PC MAGNET BY DOUGLAS BOLING Batch Files Get Even Better with STRINGS 2.0 375

Environments

PC MAGNET BY CHARLES PETZOLD Exploring the FONTMETRICS Structure, Part 1 388

Power Programming

PC MAGNET BY RAY DUNCAN Multitasking and Multithreading in Windows NT 392

Solutions

PCs: Make sure your new devices get the IRQs they need 408

Peripherals: Keep track of printer usage; search for the ideal multipurpose peripheral 408

Operating Environments: A shortcut key to access Program Manager; running DOS games under OS/2 2.0 411

Word Processing: Share dictionary files between Word for Windows and Microsoft Excel 412

Spreadsheets: Maximize your Excel start-up sheet; a formula that returns the name of a page in QPW 418

Databases: Check for a subdirectory's existence using an undocumented property of DOS 428

Graphics: Create realistic perspective space in CorelDRAW; precisely align Animator Pro animations 438

Networking: Burst mode doesn't work with Windows—yet; sharing spreadsheet data over a LAN 446

Languages: C macros that make it easy to create variable-argument functions in C and C++ 446

On-Line: Logging on to ZiffNet with Procomm Plus 446

AFTER WORDS

After Hours

Holiday Gift Guide

This holiday season, deck your computer with software the whole family will enjoy. In our fourth annual Holiday Gift Guide, we recommend games, music programs, children's software, CD-ROM titles, and personal productivity packages that can make a home PC fun for everyone 528

Abort, Retry, Fail?

BILL HOWARD 534

ALSO IN THIS ISSUE

PC Direct 399

Marketplace Index 497

Premier 497

Reader Service Card 501

Classified 510

Business Card 519

Index to Advertisers 523

Advertisers' Product Index 524

Coming Up 526

Editorial Product Index 527

Holiday Gift Guide: Mystery, adventure, and puzzles abound in this season's best computer games (page 528).

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Subscription Rate: The subscription rate is $44.97 for a one-year subscription (22 issues). Canada and all other countries, please add an additional $32.00 for postage. GST Registration Number: R-123669673.

Back Issues: For back issues (subject to availability), $8 per issue ($9 outside the U.S.), send check or money order to Back Issues Dept., Ziff-Davis Publishing Company, P.O. Box 53131, Boulder, CO 80322-3131.

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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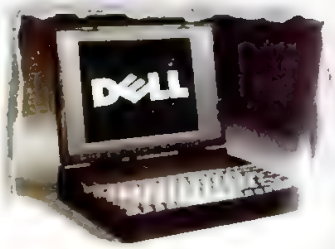

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No Comparison.

Notebook Features	Austin 386/SXL25	Dell 325N
Memory	**4MB**	4MB
Hard Drive	**60MB (120MB Capacity*)**	60MB
Built-In Track Ball	**Yes**	No
S/R Fax Modem (9600B Fax/2400B Data)	**Yes**	No
Battery Life	**4 Hours**	3.5 Hours
Tech Support	**24 Hours/Day**	14 Hours/Day
Money-Back Guarantee	**60 Days**	30 Days
DOS 5.0	**Yes**	Yes
Windows 3.1	**Yes**	No
PFS Window Works, Contact Manager	**Yes**	No
McAfee Anti-Virus	**Yes**	No
Carrying Case, AC Adapter	**Yes**	Yes
PRICE	**$1990**	$2149

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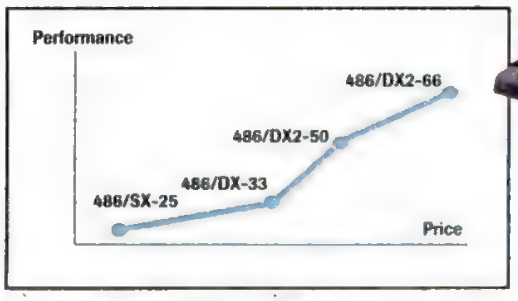

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PC MAGAZINE EDITORS' CHOICE

"Most bang for the buck!"

"The Austin 486/33i WinStation packs a lot of performance and expansion into a compact package. It is attractive, aggressive and affordable."

PC Magazine Contributing Editor Winn L. Rosch

A U S

PC-AG-2

486/SLC-33 WinStation	386/33 WinStation	486/DLC-40 WinStation	486/33LB WinStation	486/DX2-50LB WinStation
Cyrix 486SLC, running at 33MHz	Intel 386, 33MHz w/64K Cache	Cyrix 486DLC, 40MHz w/64K Cache	Intel 486, 33MHz w/128K Cache	Intel 486DX2, 50MHz w/128K Cache
2MB RAM (to 32MB)	4MB RAM (to 32MB)	4MB RAM (to 32MB)	4MB RAM (to 32MB)	4MB RAM (to 32MB)
80MB Hard Drive	80MB Hard Drive	170MB Hard Drive	210MB Hard Drive	210MB Hard Drive
14" VGA 640x480 Color Monitor w/256K Video RAM	14" VGA 640x480 Color Monitor w/256K Video RAM	14" VGA 640x480 Color Monitor w/256K Video RAM	14" VGA 1024x768 Non Interlaced Color Monitor Local Bus Video	14" VGA 1024x768 Non Interlaced Color Monitor Local Bus Video
1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives
101 Key Keyboard	101 Key Keyboard	101 Key Keyboard	101 Key Keyboard	101 Key Keyboard
DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse
Small Footprint Chassis	Small Footprint Chassis	Small Footprint Chassis	Small Footprint Chassis	Small Footprint Chassis
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486/50LB WinStation	486/DX2-66LB WinStation	486/DX2-50 EISA WinStation	486/DX2-66 EISA WinTower	386/SXL-25 Notebook
Intel 486 running at 50MHz w/128K Cache	Intel 486DX2 running at 66MHz w/128K Cache	Intel 486DX2 running at 50MHz w/128K Cache	Intel 486DX2 running at 66MHz w/128K Cache	386SXL running at 25MHz 2MB RAM (to 8MB)
4MB RAM (to 32MB)	8MB RAM (to 32MB)	8MB RAM (to 32MB)	8MB RAM (to 32MB)	120MB Hard Drive
210MB Hard Drive	210MB Hard Drive	330MB HD, EISA SCSI Cont	330MB HD, EISA SCSI Cont	9.4" VGA LCD Display 640x480 w/32 gray scale
14" VGA 1024x768 Non Interlaced Color Monitor Local Bus Video	15" VGA 1024x768 Non Interlaced Color Monitor Local Bus Video	14" VGA 1024x768 Non-Interlaced Color Monitor w/Windows Accelerator	15" VGA 1024x768 Non Interlaced Color Monitor w/Windows Accelerator	1.44MB Floppy Drive Built In Track Ball
1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	79 Key Keyboard DOS 5.0
101 Key Keyboard	101 Key Keyboard	101 Key Keyboard	101-Key Keyboard	Pre-Installed
DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	6.2 lbs with battery
Small Footprint Chassis	Small Footprint Chassis	Small Footprint Chassis	Tower Chassis	
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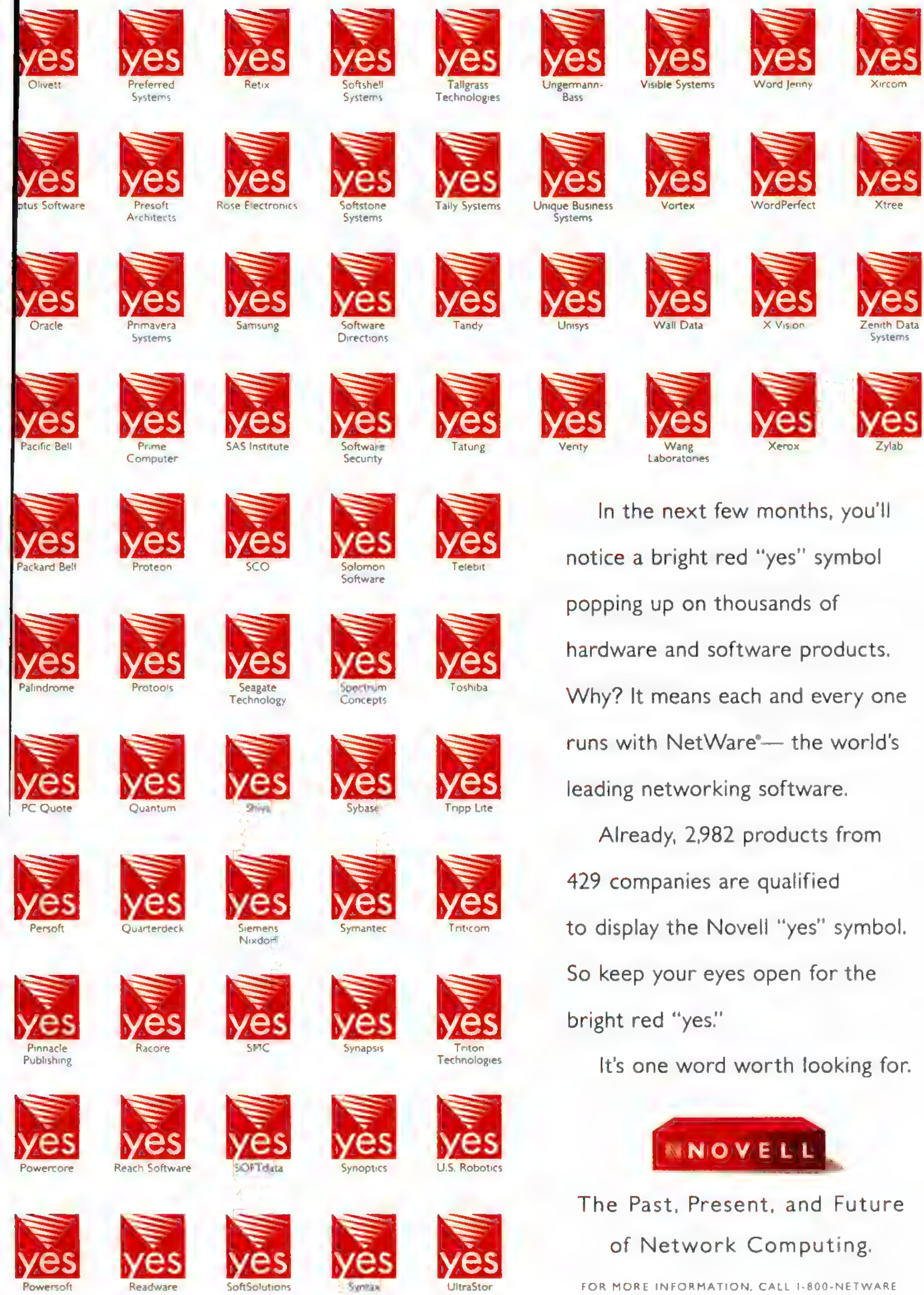

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Letters

UBIQUITOUS DOS

Thanks for finally coming back to Earth with "DOS Lives!" (October 13, 1992). It's about time *PC Magazine* remembered that most of its readers live and work in a DOS world. The shame of it is, it was probably a one-time-only kind of article.

Now don't assume from the comments above that I'm somehow irretrievably stuck on DOS. I agree completely with the sidebar "DOS Must Die!" that accompanied the article. I usually work in XTree so I can avoid the DOS command line, and I use a raft of DOS extenders to avoid the 640K limit.

The difference between my position and *PC Magazine*'s is that I consider the alternatives suggested up to this point (Microsoft Windows and OS/2) to be unacceptable. Both force the user to work with a GUI's renowned and excessive overhead and hardware requirements. Thanks but no thanks!.

Charles Head
Arlington, Virginia

DOS indeed lives! Congratulations on a good story and for providing several usable tricks for even this dedicated DOS user. I've finally removed Windows from my machine.

Windows allows you to avoid thinking while you work. That's okay if you have a superfast computer with a big hard disk, but during the coming decade of economic stringency, most people won't choose to invest in excessive hardware and unnecessary interfaces.

DOS allows programmers to seek more efficient ways to do more jobs without necessarily maximizing hardware. That's the evolutionary impulse. The lean and hungry competitors in this world don't need a GUI to spoon-feed them.

James K. Gordon
Chevy Chase, Maryland

BAMBOOZLE THE VIEWER? NO WAY!

Our "demo pak" that appeared to catch John C. Dvorak off guard ("The Demo Dilemma," October 13, 1992) is far from useless if prospects and customers are any measure.

Congratulations on a good story and thanks for the usable DOS tricks.

We do agree that self-running demos are really just glorified slide presentations and don't honestly represent the intrinsic value of a software product. But Mr. Dvorak, what do we do about the thousands of prospects who see Westbrook Technologies ads and call our 800 number? Shipping full-boat evaluation copies can quickly get out of hand. What's great about today's software advancements is that they have given us the ability to send a working demo disk that delivers a quick, real feel for our product and its capabilities.

Of course the demo disk is a sales tool. Bamboozle the viewer? No way! It's no less legitimate than the pieces of literature that cross your desk and serve as background for your editorial decision making.

Michael Graham
V.P. Marketing
Westbrook Technologies Inc.
Westbrook, Connecticut

WORKS WORKS

I would like to thank John C. Dvorak for his insightful review of subnotebook computers, "The Perfect Portable?" (October 27, 1992). As is normally the case, Mr. Dvorak tells it like it is. However, to call Microsoft Works "downright embarrassing and awkward" shows how completely out of touch he is with most computer users.

Microsoft Works is the best integrated program for home or office and is perfect for notebook users. I use Works for DOS on my notebook and Works for Windows on my desktop and they are the true workhorses of my systems. It would be nice to have all of the latest programs at my fingertips, but unfortunately my budget can't handle that.

Doug Stephens
St. Charles, Idaho

IS THE FUTURE ON DISK?

I don't agree with Michael Miller that CD-ROMs are going to take off, as he stated in "Backstage with CD-ROM" (September 15, 1992). It's true that CD-ROMs are great for software distribution, and that they will most definitely replace the floppy disk for large software packages. But how can a company manage a 100-node network with 100 CD-ROM drives, and leave it to the end user to ensure that the correct CD is mounted accordingly to the application he or she is using?

Alberto Pace
Geneva, Switzerland.

ELECTRONIC ADDRESS PLEASE

In the age of PCs and e-mail, where are the e-mail addresses of *PC Magazine*'s editors, columnists, and reviewers? Other magazines list the Internet, MCI, and CompuServe addresses of their editorial staffs. Where are yours? In this supposedly advanced age of computers and electronics, I have to send a letter to your publication on paper.

Could this be an indication that *PC Magazine* is getting out of touch?

Jerry L. Rowe
Marion, Indiana

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LETTERS

RECONSIDERING PC POWER

In "486SX: The New Entry-Level PC" (October 13, 1992), you said the power of the i Corp Blazer IIs is "wasted on the 486SX." For just $699, however, owners can easily upgrade in the field to 80 MHz, 59 VAX MIPS, with a Winmark rating of over 26! The 80-MHz upgrade includes more air conditioning; an active, solid state, thermoelectric (Peltier) refrigerated CPU chip; and a third fan, all in the same "great" case that *PC Magazine* has called "an ideal file server" in the past.

Of the 58 systems tested in your review, the Blazer IIs tested fastest on both processor and memory tests. Your disk tests also show that the Blazer IIs (i Corp's slowest model) had far more throughput than 56 other systems included in your review, even after PC Labs handicapped the Blazer by replacing our 56-MHz crystal with a 50-MHz one.

George Beard
President, i Corp
Boston, Massachusetts

• We clearly stated in our review that the Blazer IIs turned in average benchmark test peformance scores when the clock speed of the system was reset to 25 MHz. We still believe that pushing a CPU beyond Intel's recommended clock speed is risky.

While it's true we admired the same case on a Club AT system almost two years ago (February 12, 1991), the file-server market has, of course, changed significantly since then, and what was worthy of praise in early 1991 isn't necessarily worthy of praise now.—Ed

DAVID: A COMPUTER FOR THE BLIND

In Advisor (September 15, 1992), you point out that "no one company makes a complete system for the visually impaired." While visiting the Rehab-Fair in Karlsruhe, Germany, I came across a company, Baum Electronic, which does just that. Their system, a 20-MHz 386SL with an 80MB hard disk, is called David. Unlike other laptops, David does not have an alphanumeric keyboard, but rather a Braille keyboard.

Software for reading and speech output, as well as the most current version of MS-DOS, are included with the system. Manuals are also in Braille.

Uwe Kosa
Heidelberg, Germany

LOG ON, TUNE IN!

William F. Zachmann's "Need Information? Get On-line!" (October 13, 1992) hit the nail on the head. When it comes to PCs, the information revolution is just the tip of the iceberg. Having a computer without a modem is like having a television without cable service. You can watch TV without cable, but you are limited to a few channels. With a modem, you have the ability to connect your PC to the world. Every computer user should buy a modem and log on to a computer service or a local BBS.

Nick Berdeguez
Matthews, North Carolina

> ***A computer without a modem is like television without cable service. A modem gives you the ability to connect your PC to the world. Every computer user should have one.***

HAS YOUR HEALTH CLUB CLOSED?

Having just read the review of the Dell System 320SLi (First Looks, October 13, 1992), I feel compelled to respond with a resounding yawn. There are numerous notebook computers already on the market that come in at under 5 pounds. I believe that if you find your body experiencing aerobic shutdown when you carry 1 extra pound over Dell's 4-pounder, you should seek better physical conditioning, not a lighter computer.

Stan Stoler
Westwood, New Jersey

FONTS, FONTS, AND MORE FONTS!

I would like to thank *PC Magazine* for its extensive feature on fonts, "Typecasting: Choosing and Using Fonts" (October 27, 1992). I think you should warn you readers, however, that Microsoft Word for Windows, Version 2.0, has a big problem once you have more than 255 fonts available. (Microsoft Corp. has acknowledged this.) The software's font combo box omits some fonts while duplicating others. This problem gets more severe as you add more fonts to your system. This has created great problems, since I have about 450 fonts installed.

Eric Grunin
New York, New York

CORRECTIONS AND AMPLIFICATIONS

The price for the Intel Above Board ISA (New & Improved, October 13, 1992) configured with no RAM is $229.

In "Token-Ring Adapters for the PC: Poised for an Explosion" (October 13, 1992), we incorrectly stated in the features table that Thomas-Conrad does not sell Multistation Access Units. The company does sell MAUs. The correct phone number is 512-836-1935.

In the same article, the Performance Index results for the 2- and 3-adapter tests should have been divided by 2 and 3, respectively.

In the October 13, 1992, review of 25-MHz 486SX systems, *PC Magazine* incorrectly quoted the price of the Compaq Deskpro 486S/25M as $4,276. The correct price is $3,546.

After the December 8, 1992, review of fax software went to press, SofNet changed the name of its Faxit product line. The new name is FaxWorks.

HOW TO WRITE TO PC MAGAZINE

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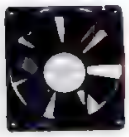

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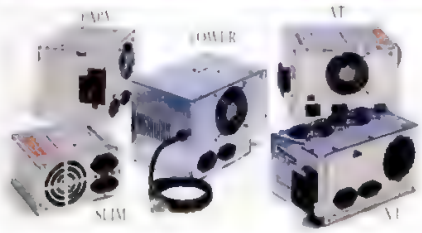

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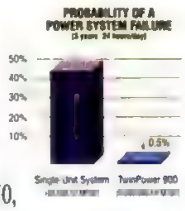

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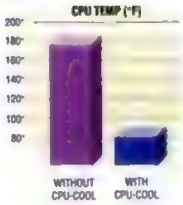

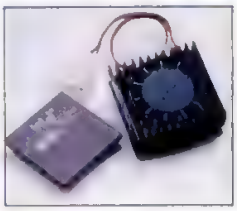

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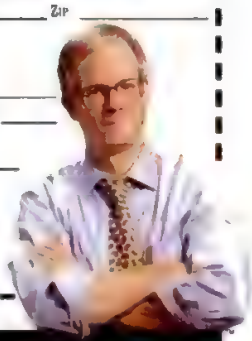

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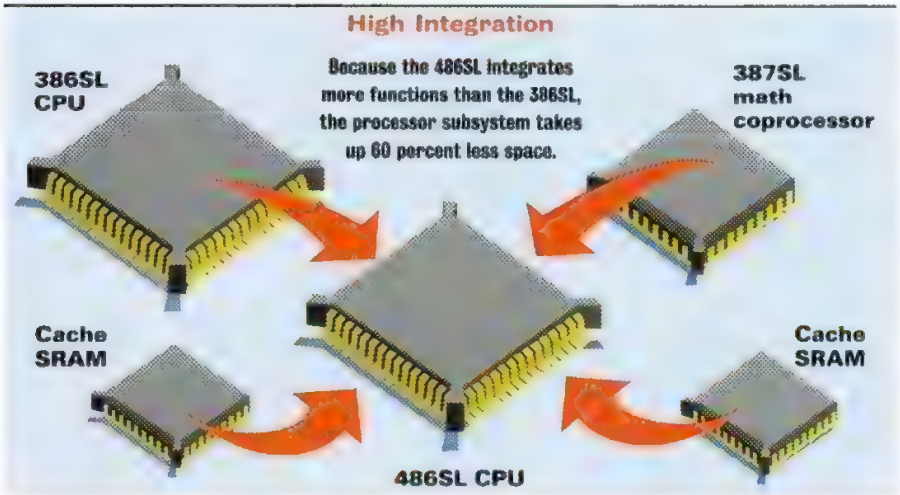


True Brawn, Low Power

Intel's low-voltage 486SL arrives.

The Pentium (the unfortunate new name for the P5 or 586 chip) has been the Intel newsmaker of late, but the company's second-generation notebook-specific 486SL has made a few headlines, too. The 486SL gives PCs low voltage, high performance, and a local-bus interface to speed video.

Operating the CPU at 3.3 volts, the first 486SL systems should use about 25 percent less power than a standard 5-volt portable PC, although the first systems will be mixed voltage (3.3 and 5 volts) until 3.3-volt display panels and drives are available next year.

Intel was not the first to introduce a 3.3-volt CPU. Advanced Micro Devices beat it out the door with the 25-MHz Am386-SXLV. Upstart Cyrix is nipping at both Intel's and AMD's heels with its 3.3-volt Cx486SLC/e-V25 and Cx486SLC/e-V33. But Intel is ahead by a hair as the first chip maker to market with a full 3.3-volt 486 CPU. Unlike the others, Intel's 486SL has a 486DX core (including math coprocessor capabilities) that executes instructions in one clock cycle (as opposed to two in 386s), and it has an 8K on-board cache, a 32-bit data path, and a local-bus interface.

Ignoring the low end, Intel will ship mostly 25- and 33-MHz versions of the 486SL, although a few system vendors are opting for a special 20-MHz version. Owing to the limited availability, high cost, and late delivery of the chip from Intel, only two vendors were expected to have systems ready in time for Intel's 486SL launch this winter: Compaq and NEC Technologies.

The Compaq LTE Lite 4/25c is the first notebook to use the 25-MHz 486SL. It's a 6.5-pound active-matrix color notebook. The LCD panel and drives will operate at 5 volts, but the 3.3-volt components will help it eke out an extra half-hour of battery life.

NEC is pursuing its pen-based agenda with the UltraLite Autograph. The Autograph uses a special 20-MHz version of the 486SL. Weighing under 4 pounds, the $3,699 Autograph has two PCMCIA sockets, a 9.4-

Continues on page 32

Faster Printing With Windows

PRINTING DOCUMENTS UNDER Windows may soon take only one-tenth the time it does today.

For years, Microsoft has promoted replacing the printer's imaging model (HP PCL and PostScript, for example) with the operating system's (in Windows, the Graphics Device Interface). So far, LaserMaster has been the only company to embrace the concept fully.

But Microsoft will heed its own advice when it enters the LaserJet add-on cartridge market early next year. The Microsoft Windows Printing System will work with all HP LaserJet II and III printers. With support for GDI calls, it promises to increase printing speed anywhere from two to ten times. And with an expected list price of around $200, it will cost significantly less than competing products, which start at $350.

Microsoft, working with Hewlett-Packard, has carved out specs that will make new parallel ports bidirectional (and high-speed) but the company has also figured out how to communicate dynamically with existing parallel ports. Raising the bar on ease of use and convenience, the Windows Printing System tells you how long it will take to print a file, sends specific messages if you need to do anything (add letter-size paper, for instance), and provides an ongoing animated status report.

—*Mary Kathleen Flynn*

Swiss Army Knives

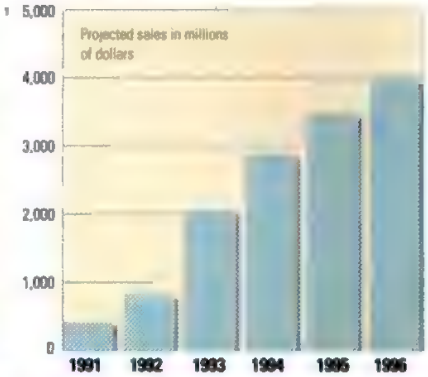
EVERY COUPLE OF YEARS IT HAPpens again. Someone decides to put a printer, a copier, a fax, and a scanner all into one box. And while some of these "hydras" have made it to market, none of them was really the machine you'd want on your desktop. But now we're finally seeing a wave of products that make putting all your paper-management needs into one machine a real possibility.

There are two basic approaches to creating a single-stop printing solution. One is to buy a multipurpose machine, the other is

grow your own multifunction device by adding modules.

Look for modular approaches in units such as Canon's JP55, expected to ship in the first half of 1993. The JP55 will let users select which functions they want, such as printer, fax, copier, scanner, and/or optical disk. Similarly, three of this year's new printers—the NEC Silentwriter Model 95 ($1,749), and the Compaq PageMarq 15 ($3,999) and PageMarq 20 ($5,499)—offer add-on Adobe PostScript fax options. (To read reviews of these printers, see the November 24, 1992 issue of *PC Magazine*.)

Sales of Multifunction Peripherals to Rise



Source: BIS Strategic Decisions

Other modular products target an installed printer base. For instance, the $1,395 HP LaserJet Fax adds fax capabilities to LaserJets. Alacrity Systems' $1,995 Desktop Document Manager gives copier and fax abilities to users with an HP LaserJet II or III or IBM Lexmark 4019 Series unit and a scanner.

The second approach involves delivering the whole package up front. The key to success with the all-in-one approach is offering a single package that outdoes—in both cost and performance—the combination of the separate components.

The $3,999 Okidata DOC*IT 3000 and $4,999 DOC*IT 4000 represent the low-cost segment of the all-in-one market. With DOC*IT, users can merge hard copy—say, a scanned newspaper clipping—into an electronic file, edit the file, and then fax, print, or file the final piece.

At the high end are heavy-duty units, such as the Xerox DocuTech Publishing Series, a digital copier-based unit that churns out 600-dot-per-inch prints at speeds of up to 135 pages per minute. But the DocuTech's heavyweight price tag keeps it in a niche market: A networked DocuTech with Media Server costs over $270,000.

Currently, the only color multifunction device is the $6,995 Canon CJ10 Desktop Color Bubble-Jet Copier. When attached to a personal computer via a $2,700 Intelligent Processing Unit, the CJ10 acts as a scanner, printer, or copier.

For users looking for complete multifunctionality, Digital Design offers its Gateware 3370 Multi-Function Technology: For $3,995 (and up), you can buy a combination printer, copier, fax, scanner, and 486 PC. Gateware systems are expected to reach the market some time next year.

These multifunction devices use little new technology, but they represent a leap forward in integration and ease of use. And if market-research firm BIS Strategic Decisions is right in predicting that the multifunction market will reach $4 billion by 1996, then it's a safe bet that a lot of users have been waiting for a better way to handle their paper.—*Catherine Kunkemueller*

Pipeline *By Robin Raskin*

Standard for Every Room

Today, when you buy software you've got to know enough to choose a platform and a media format. You also need to be able to decipher a bit of packaging information about the plethora of peripherals, and to be mindful of version numbers. But things could always be worse. In fact, it looks like they will be.

Soon you may have to decide where and when you're going to be using your software in order to choose the right medium. Shopping for software will be as depressing as shopping for music is now. My local "record store" (now, that's an anachronism) forces me to choose between a CD, a cassette, a DAT, or if I can find one, a vinyl record. My decision is usually based on the "Where am I going to be listening to this?" principle—in the living room, in my car, or while I'm out jogging.

Here's a scenario from the not-too-distant PC future: My personal digital communicator is stowed away in my briefcase. It uses GO's PenPoint operating system; my software for it comes on a PCMCIA card. In my living room, I've got the family's Tandy VIS hooked up to my television. The VIS relies on Modular Windows. With Modular Windows, a hand-held controller is my input device. I've also got a Photo CD player attached to the bedroom TV that requires a CD-ROM XA drive capable of multisession playback. I've got a 2-pound portable Sony Multimedia CD-ROM Player to entertain myself on my daily commute. It uses another CD-ROM XA variant, MMCD—Sony's proprietary format. Finally, I've got my office PC with its aging, but functional, single-session ISO-format CD-ROM. Of course, if I were totally masochistic I could have a Philips CD/I player and Commodore CD TV, too. Both are proprietary machines that look very much like audio compact disk players and make using CD-ROM software effortlessly easy.

Each and every one of these devices is capable of playing some great CD-ROM software. But each uses the greatest oxymoron of our time—the so-called "proprietary standard."

Suppose I want to buy a reference encyclopedia? What I really want to buy is the content, but I'm forced to think mightily about the container. "Where will I be looking things up most often?"

Developing software titles for these machines doesn't require any Herculean effort, so it's likely that smart developers will hedge their bets and produce the same titles for a few formats. According to Broderbund, porting a Windows app to a Modular Windows platform is relatively easy. Fine for the folks at Broderbund, but what about me? The Modular Windows version of Grandma and Me won't run on my PC, and vice versa.

PHOTOGRAPH BY PETER GRECO

Compton's New Media has announced that it will be one of the first vendors to produce software available on every possible platform. There are versions of Compton's Encyclopedia for MPC Windows, CD/I, MMCD, and Modular Windows, with more underway. These are not interchangeable, however, and each costs $395 to $695.

In the hysteria to keep the PC out in front of the converging electronics/computing market, hardware and software vendors alike deserve a hearty thumbs-down for pretending to give us new standards and open systems, when they are really forcing us to buy machine-specific applications.

Robin Raskin is an executive editor of PC Magazine.

Electronic Democracy?

ROSS PEROT MAY HAVE INTRODUCED the concept of electronic town meetings to some Americans, but many local and federal government agencies have already jumped on the technology bandwagon, offering computer access services that make it easier to gather information, get involved in community affairs, or even find library books. Usually taking the form of a bulletin board system, these services offer anyone with a modem the opportunity to dial in, download information and, in some cases, leave comments for public officials.

One of the most ambitious projects is the City of Santa Monica, California's Public Electronic Network (PEN), a public access network open—and free—to anyone who lives or works in the city, according to Lisa Kemp, PEN administrative analyst. PEN receives about 7,000 calls each month from residents who want to send electronic mail to city departments, read one of the dozens of bulletin boards, or have a real-time chat in a forum such as Rent Control, Homeless Discussion, or Ecology. But what makes PEN different from other bulletin boards are the 35 public terminals around town. "They're in all the libraries, the City Hall lobby, parks, neighborhood support centers, and senior recreation centers," says Kemp. (For information, call 310-458-8383.)

Publicly sponsored bulletin boards include the Queens (New York) Library system's Electronic Doorway, a free 24-hour search service with the combined card catalogs of its 63 branches on a CD-ROM called Quick Cat (718-990-0830). The Ector County Independent School District in western Texas has a bulletin board with mail, file, and chat features designed for its students (915-332-8128). Atlanta, Georgia has the AIDSQuest Hotline offering AIDS and cancer information (404-377-9563). And Lincoln, Nebraska has a weather information board (402-472-6615). On the federal level, there are more than a hundred bulletin boards accessible to the public, run by such diverse agencies as the Federal Highway Administration (202-366-3764) and the National Weather Service (301-763-0871). NASA's board lists space shuttle schedules (205-895-0028).

As government agencies—and the public—become increasingly computer literate, democracy in the living room may become more than a campaign slogan.
—Andrew Kantor

Santa Monica's Public Electronic Network includes 35 public-access terminals.

Next-Generation Accelerators

THE CURRENT CROP OF WINDOWS accelerators may seem speedy enough, but there's a generation of faster pixel pushers just around the corner.

Video accelerator boards make running Windows seem much faster because they build certain Windows graphics functions into hardware, and because they handle some of the graphics processing usually done by the system's CPU. The first-generation accelerators, which arrived last fall, used video controller chips including S3's 86C911, ATI's Mach 8, Integrated Information Technology's UV6000, and Weitek's W5086.

Each company now has a successor that is faster than ever—several, it is claimed, are three times faster. And speed isn't the only improvement. The new chips support more colors than before, and several include advanced multimedia features such as genlocking and stretch BLTs. Everybody is hopping on the accelerator bandwagon: Even market leader Tseng, which has resisted introducing an accelerator until now, recently announced the Tseng ET 4000/W32, which has Windows functions built in.

S3 has a number of successors to the near-venerable 86C911: the 24-bit color upgrade, the 86C924; the DRAM-based 86C801 and 86C805; and the local-bus VRAM screamer, the 86C928. S3 claims the 86C928 will perform at least three times faster than last year's 86C911 under Windows. While most system vendors won't have products based on the 86C928 out until early 1993, Number Nine Computer Corp. recently began shipping its 86C928-based #9GXe board.

But S3 isn't the only game in town. ATI Technologies is already shipping the Graphics Ultra Plus and the Graphics Ultra Pro, both based on the company's new Mach 32 accelerator. It can now generate 65,000 colors at 1,024-by-768 resolution. ATI claims boards based on the Mach 32 will be three times faster than the Graphics Ultra boards based on the Mach 8.

Integrated Information Technology's progeny are the AGX-14 and AGX-15. The first board based on the new AGX-14 will be the Hercules Graphite Card, priced at $399.

Weitek's Power 9000, which is designed for local-bus implementations, is used in Orchid Technology's Celsius 9000 and Diamond's SuperStar VLB. It claims a fourfold performance advantage over ATI's Mach 8 and S3's 86C911.

Top Retail Software

Current ranking	Last issue	Product/ Company
1	—	**TurboTax** *ChipSoft Inc.*
2	7	**Quicken 6.0** *Intuit*
3	1	**WordPerfect 5.1 for Windows** *WordPerfect Corp.*
4	—	**PC Tools 8.0** *Central Point Software*
5	4	**Microsoft Windows 3.1** *Microsoft Corp.*
6	6	**Procomm Plus 2.01** *Datastorm Technologies*
7	5	**Microsoft DOS 5.0 Upgrade Kit** *Microsoft Corp.*
8	2	**QEMM-386 6.0** *Quarterdeck Office Systems*
9	10	**Procomm Plus for Windows 1.01** *Datastorm Technologies*
10	3	**Microsoft Windows 3.1 Upgrade** *Microsoft Corp.*
11	—	**Office for Windows 3.0** *Microsoft Corp.*
12	8	**Word for Windows 2.0 Upgrade** *Microsoft Corp.*
13	9	**WordPerfect Windows Trade Up** *WordPerfect Corp.*
14	—	**LapLink Pro 4.0** *Traveling Software*
15	—	**Microsoft Excel for Windows 4.0** *Microsoft Corp.*

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending October 24, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

How all these claims of increased speed will pan out remains to be seen, and tested. All that's certain is that video under Windows just keeps getting faster.
—*Christopher Barr*

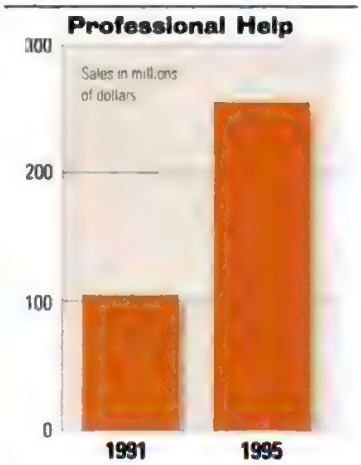
Help Desks Try To Stand Out

TODAY'S HELP DESK SOFTWARE INcludes features like diagnostic and query-by-example tools that lead technical support and customer service representatives to solutions, work flow–management tools that track and route information, and call-management tools that log calls, maintain profiles, and identify caller trends (discussed in Trends, "Help Yourself to Tech Support," September 15, 1992). Now vendors are trying to differentiate their products with advanced features that streamline the process by which information is dispensed to customers.

Software Artistry Inc. (800-795-1993) has added multimedia to Version 2.3 of its DOS-based Expert Advisor help system ($45,000 for ten workstations). Without additional hardware, Expert Advisor can display full-motion video to aid in describing advanced technical procedures over the phone. With a sound card installed, Expert Advisor can record the voice of the help desk operator and save it as part of the caller's case file for playback at a later time.

The system's hypermedia environment allows workers to access text, graphics, animation, and a variety of databases in the course of a single call. Included in the price of Expert Advisor is the program's source code, in case users want to customize the system software.

Clarify Inc. (408-428-2000) has brought an integrated Windows solution to market. The company's Customer Service Management System expands on the traditional help desk system to provide users with defect and inventory tracking. ClearSupport and the ClearSupport Diagnosis Engine ($5,000 per concurrent user) ›sic technical support system alls and analyzes problems. ClearQuality is a defect-tracking system that records defect-related information, including trends and fixes. ClearLogistics is a field-service-management and inventory-management system that tracks stock quantities at various locations. The system will interface with billing systems. Both modules integrate with ClearSupport.



Source Dataquest/Ledgeway

Sales of off-the-shelf help desk software will more than double by 1995.

A third vendor, ProActive Software (415-691-1500), is shipping Support Advantage as part of its Customer Information Resource (CIR) system at $15,000 per five users. Like Clarify's suite of products, the Windows-based CIR system includes modules for field engineering and quality control while adding a module for sales-lead tracking.

Where the CIR system makes headway is in ease of customization. The ProActive Toolset ($8,000) is an object-oriented environment that allows for the system to be tailored to the needs of the help desk worker without changing the source code.
–*Brad Grimes*

Briefs

TAP DANCING MAY STILL BE BEYOND THE elephant's ken, but IBM is clearly learning some new steps. Literally the day after Compaq slashed its prices, the IBM PC Co. responded by lowering the prices on ValuePoint computers it was unveiling that same day. At an informal lunch with executives (the format the company has embraced to introduce new products to the press), the quick decision making was clearly evident from promotional materials that had been hastily hand-corrected the night before. When it comes to footwork, sometimes fast is better than fancy.

A COMMON METHOD OF CONTROLLING desktop systems and their components over the network is being developed by the Desktop Management Task Force, an impressively large and varied group led by DEC, HP, IBM, Intel, Microsoft, Novell, SunConnect, and SynOptics. Wisely independent of operating system or net-work management protocol, the Desktop Management Interface will give hardware and software developers a simple way to manage components such as video and LAN adapters, applications, and even operating systems. It will also let network management systems control desktop units and their components. A draft of the API architecture is expected to be finalized by spring.

EVENT MANAGERS AREN'T THE ONLY ONES who like to plan ahead. To be sure you don't miss a single computer trade show or conference on the planet, buy Tech Trade Events' $40 1993 Technology Events Calendar and $60 Events Management Software. In addition to show descriptions and contact information, you'll get a monthly trivia question from the Boston Computer Museum's Computer Bowl (201-941-3675).—*Mary Kathleen Flynn*

Intel's 486SL Arrives

CONTINUED FROM PAGE 29

inch screen, 40MB or 80MB hard disk, and either Microsoft's Pen Windows or GO Corp.'s PenPoint. NEC chose the 486SL because both PenPoint and Pen Windows need all the processing power they can muster to run at acceptable speeds, and because of the chip's fast Peripheral Interface (PI) bus.

Like Intel's forthcoming Peripheral Component Interconnect in desktop systems, the PI bus gives peripherals access to the local bus in notebooks. When video controllers that can hook into the PI bus are developed, system makers will be able to operate video at the faster CPU speed rather than the slower 8-MHz ISA bus speed. NEC plans to release a redesigned UltraLite notebook based on the 25-MHz 486SL shortly, but other vendors report some problems implementing the PI bus and don't expect to deliver systems using it until later next year.

Other notebook makers working on 486SL designs are Dell, Toshiba, and Zenith Data Systems. NCR won't have a 486SL system any time soon, but plans to use the chips in all of its notebooks by the end of 1993.

If you worried that notebooks would be left out of the DX/2 clock-doubled ball game, rest easy. In 1993, both Intel and Cyrix plan low-voltage, clock-doubled chips for notebooks.—*Christopher Barr*

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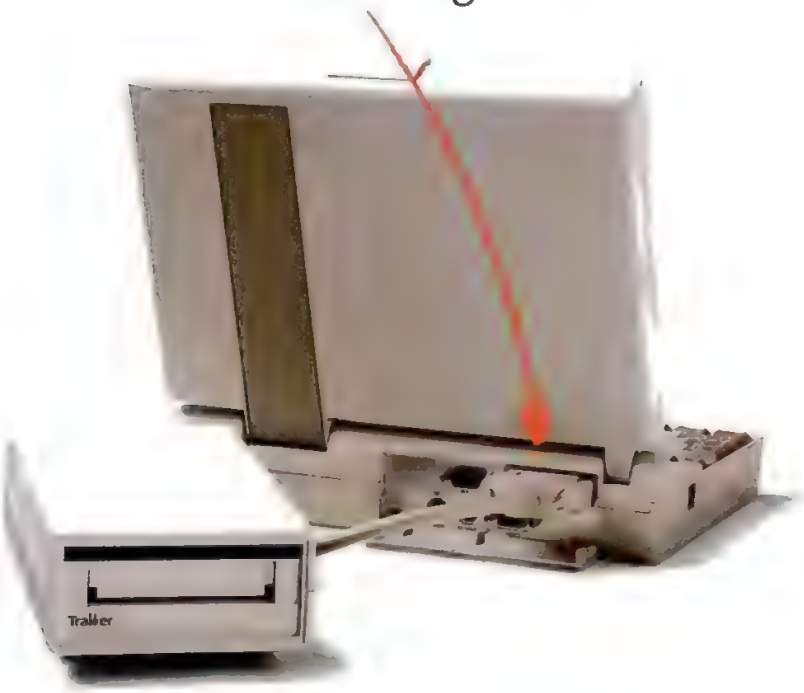
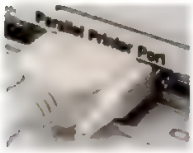


That's it. Go Play.



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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

Databases

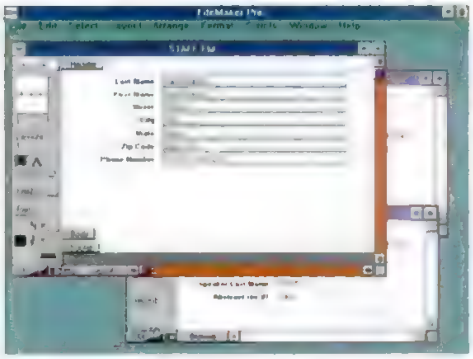
FileMaker Pro: A Smooth Trip from Mac to Windows

BY RICHARD HALE SHAW

Claris Corp.'s FileMaker Pro for Windows has a feature offered by no other Microsoft Windows–based database manager: an identical Macintosh version of the product and complete file-compatibility between the two. Consequently, you can run the Windows and Macintosh versions on the same network, and share data and files with complete transparency. The catch? Windows-specific features—like Dynamic Data Exchange (DDE) and Object Linking and Embedding (OLE)—aren't supported at all.

While it's new to Windows, Macintosh users are old friends of the $399 FileMaker: It's long been a popular data manager on that platform. But Version 2.0, released simultaneously on the Macintosh and for Windows, offers scripting, TrueType font support, and multimedia features that weren't available on previous Macintosh releases of the product.

File definition in FileMaker is simple and impressive. You can type in a field name with little concern for its length, and you can change field order by dragging and dropping. Fields can contain sound, video, and graphics, as well as text, numbers, dates, and times. Creating calculated fields (there are over 70 functions and formulas available), summaries, or auto-lookup fields is easy. And field management is simple and safe: You can add, change, or remove fields at any time without losing your data.



DRAW A FORM: *Layout mode lets you add, arrange or remove fields and graphics.*

FOUR MODES

FileMaker uses four operational modes, Layout, Preview, Browse, and Find, among which you switch with a mouse click. You use Layout to design different database views or "layouts." While FileMaker supports Windows's Multiple Document Interface (MDI) for displaying multiple windows, it only lets you display one layout at a time. Preview mode lets you preview a layout, and Browse and Find use layouts for viewing, editing, and searching for records.

• *Continues on page 38*

Utilities

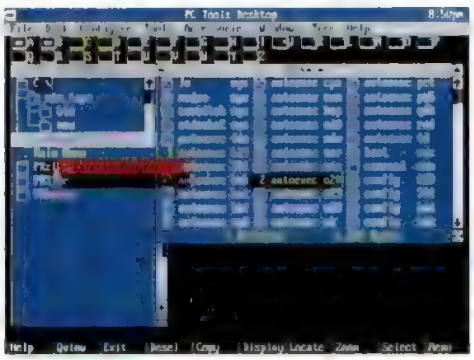
PC Tools, Version 8.0, Adds Expert-Level Utilities

BY EDWARD MENDELSON

PC Tools has always packed more DOS utilities into a single package than anything else on the market. For the first time, the new version of Central Point Software's $179 cornucopia offers utilities in which, despite some minor glitches, quality matches quantity.

PC Tools' familiar file-management and disk-maintenance utilities have grown more consistent, and Version 8.0 now gives advanced users a powerful disk editor and a customizable utility that optimizes memory managers such as QEMM-386. Most of the utilities, including undelete, work across NetWare LANs.

Version 8.0 omits the Microsoft Windows versions of the backup and other programs that were in Version 7.x; a separate Windows counterpart to the whole package is in the works. But DOS users now get a task switcher that lets you hotkey among eight open applications; network- and remote-computing utilities that let you map drives on other machines so that DOS thinks they're on your computer; and a massively improved communications module with scripting, terminal emulation, and Zmodem support for high-speed file transfers. The package now includes the full version of Central Point's antivirus software.



SHELL: *PC Tools lets you drag and drop a group of files to be executed by a program.*

The PC Shell file manager, still the heart of the package, uses a quasi-graphics display with a tree and file window, plus an optional third

• *Continues on page 39*

IN FIRST LOOKS

Canon BJ-200 40
Microsoft Windows for Workgroups Special Report 42
IBM ThinkPad 700C 44
Tandy Sensation 46
Image Assistant, Version 1.0 48
AddImpact! Version 1.0 49
Conner Peripherals Sof-Stor 49
Arco Electronics AC-1079MC 50
SurveyFirst, Version 1.0 50
AST PowerExec 51
Microsoft Money, Version 2.0 51
SmartForecasts, Version 3.0 54
American Heritage Dictionary, Second Edition 54
Q+E, Version 5.0 55
Pacific Data ProTracer 55

FileMaker

CONTINUED FROM PAGE 37

You can open up to 16 files, but there's no easy way to create one-to-many file relations. Layouts are formats for viewing, entering or printing data, and include data entry and output screens, forms, reports, multiple record views, labels, envelopes, and summaries. You can drag and drop fields and graphics (FileMaker offers built-in support for .PCX, .DIB, .GIF, EPS and other graphics formats).

GRAPHICS TOOLS

FileMaker supplies the usual bevy of graphics and drawing tools for designing layouts and reports, with a color palette, line weights, circles and rectangles, font support, and fill patterns. There's even a button to switch between inches, centimeters, and pixel rulers, and there are full alignment and zoom capabilities. You can use check boxes, radio buttons and pop-up lists for point-and-click data entry. The font support menu is a delight: Rather than the usual font-selection dialog, you get a menu with every font name simultaneously displayed in its own font. This takes some getting used to, but it makes a lot of sense.

FileMaker supplies seven predefined layouts. The Standard layout displays one record per screen, with fields displayed in the order in which they are defined; Columnar layout displays fields in a columnar fashion, one record per row, with multiple records per screen. There is also standard label layout with predesigned selections for nearly every available Avery label, an envelope layout, a single-page form layout, and a blank layout. In each case, you can start with a predefined layout and modify it to fit your needs.

In Browse mode, FileMaker's book icon lets you navigate the database: Click on one page to go backward, and the other to go forward. The icon's slider lets you scroll through the entire database. And you can use Search mode to search for or filter subsets of a database using any user-defined layout. Search parameters can include wildcards, ranges, values greater than or less than, Booleans, exact matches, and empty-field and duplicate-value searches. You can also search for embedded text.

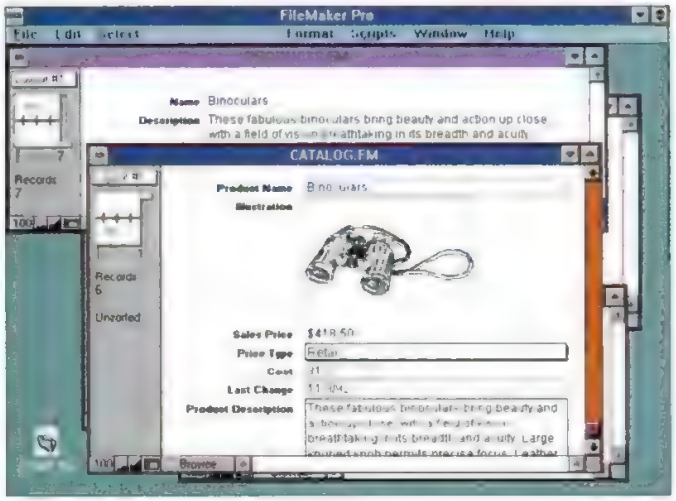
SCRIPTING LANGUAGE

Like other nonprogrammable Windows data managers, FileMaker shuns a programming language. Instead, it offers a mouse-driven scripting language that lets you codify repetitive operations. When you create a script from an object, FileMaker automatically generates a script based on the steps you've taken. This can then be the basis for a new script, which you can add to or modify as needed.

Script steps are simple, English-like descriptions of an action; for example, "Paste Last Record...", or "Go to Next Field". You can tie a script or a command to a button to add functionality to a layout. Once you complete a script, FileMaker will automatically add it to the Script menu. Unfortunately, the error-checking function is weak. If FileMaker can't execute a step, the step is skipped, and there's nothing to indicate how you can trap these errors.

FileMaker comes with seven templates that you can use to build applications. The Contacts template tracks customer information and can print Fax cover sheets, envelopes and mailing labels. A Sales Lead template produces call logs, schedules meetings and callbacks, and prints follow-up letters.

You can use the Product template to store product and vendor information and even store a graphical image of a product; the Expense template tracks income, expenses, and bills; the Invoice template organizes orders, payments, sales tax, invoice aging, and prints invoices and packing slips; and the Projects template tracks resources and milestones for a project.



IMAGEBASE: *FileMaker shows its Macintosh heritage.*

WORKGROUP ENABLED

FileMaker was born for workgroup computing. It features dynamic link libraries (DLLs) for sharing files on NetWare and AppleTalk networks, built-in record-locking, auto-update, and multi-level passwords for restricting access to selected layouts and fields. Printer support includes most laser and PostScript printers. FileMaker can import and export a wide variety of file formats, including text, BASIC, .DBF, .DIF, SYLK, and .WKX.

Both Windows and the Mac offer support for TrueType fonts and fonts provided by Adobe's Type Manager. Consequently, FileMaker layouts that use these fonts are portable to both Windows and the Mac. Both versions let you store sounds in a database, and the Windows version can record and play back sounds through any Windows Multimedia sound board (such as Creative Labs' Sound Blaster).

FileMaker is long on features. Its auto mail-merge function allows you to merge form letters created with Microsoft Word and WordPerfect. A memory option lets you cache disk writes to conserve battery time on laptops. You can create serialized, auto-enumerated fields. In addition, there are built-in utilities for creating backups, duplicate files, and compressed files, or for creating your own templates. The tutorial is easy to follow, and by building on the existing templates, you can be up and running in no time.

Claris is offering competitive "trade-ups" for $99 to users of Alpha Four, dBASE IV, Paradox, PFS File, Q&A, and R:BASE to name a few. While other Windows databases such as Approach and Microsoft's upcoming Access have a strong advantage over FileMaker because of its lack of DDE and OLE support, if you're looking for a database that runs identically on the Macintosh and Windows, FileMaker is for you. □

FACT FILE

FileMaker Pro for Windows, Version 2.0

Claris Corp., 5201 Patrick Henry Dr., Santa Clara, CA 95052; 408-727-8227

List price: $399.

Requires: 2MB RAM, (4MB recommended) 3MB hard disk space, Microsoft Windows 3.0 or later.

In Short: A feature-packed Windows-based database manager with an identical Macintosh counterpart. Very easy to use, but lacking in Windows-specific features such as DDE and OLE.

428 ON READER SERVICE CARD

PC Tools

CONTINUED FROM PAGE 37

window with menus of applications that the installation program finds on your disk or that you add manually. A customizable top-line menu gives access to file-management functions and other PC Tools applications. A customizable bottom-line menu match-es the features that you can map to three shift states of the function keys.

The shell now incorporates drag-and-drop file manipulation of the kind introduced to DOS by The Norton Desktop for DOS. You can select one or more files and drag them to the bottom line menu for deleting, copying, and other built-in functions, or simply drag them between windows for copying. You can drag a filename icon to the menu window and drop it on the name of an application to make that application load the file. Surprisingly, you can't configure the application menu to prompt you for a filename when you load a program, as you can with Norton and other advanced menu programs.

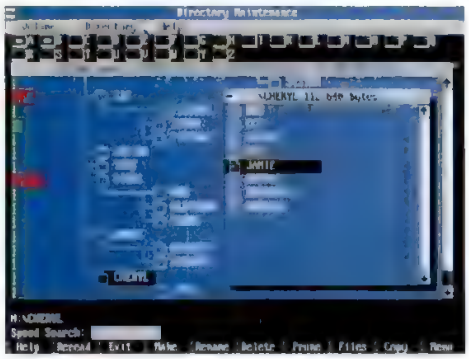
The PC Tools shell lets you view only one or two directories at a time, and if you have two directories on display, you can not use the application menu window.

One oddity of PC Tools menu is that it lets you display a window with a list of files that you've searched for, but doesn't let you use many of the functions on the bottom-line menu of those files. Another oddity lets you open a window with files found in a search but doesn't let you use the application menu to work with the files listed in the window.

The directory window responds slowly to the mouse click that you use to select a file, so you may repeat the click and inadvertently deselect the file you wanted to select. Central Point built in the delay as a way to recognize whether you want to drag or merely select the file. Norton is snappier.

TASK SWITCHING

One crucial feature you won't find in Norton is PC Tools' task switcher. It doesn't offer the automated startup options of Back & Forth Professional or Software Carousel, but it is fast and occupies only 18K of RAM. A customizable hotkey pops up a list of running applications and lets you run a new one.



HOW BIG? *PC Tools displays the size of your directories with a colored graph.*

Central Point's disk utilities, already strong in earlier versions, show subtle but important improvements. The backup program has shed its bugs, and now works with SCSI tape drives and many QIC 40/80 drives that use proprietary controllers like Mountain's Mach2 board.

The disk editor matches the power of the one in The Norton Utilities and adds a one-step option to synchronize both copies of your file allocation table. Like Norton's, this program should be used only by experts, and sensibly defaults to read-only mode.

The latest version of PC Tools' defragmenter is faster than before, and the disk cache, which needs more RAM than Norton's, shows minor improvements in performance and compatibility. Prune and graft, undelete, and other disk maintenance programs run effectively from the shell or as standalones. PC Tools' undelete options include a terminate-and-stay-resident (TSR) program that warehouses deleted files. A file-repair utility automates restoration of spreadsheet, word processing, and database files.

The unique RAM-Boost utility works with memory managers such as QEMM, 386MAX, and DOS 5.0 itself in an attempt to squeeze more device drivers and TSRs into high memory. It creates a configuration file that expert users can tweak for even better performance. You should run the optimizing program in your memory manager first, then use RAMBoost and see if you get any improvement. If you use QEMM's Stealth option, you'll get better results without RAMBoost, but otherwise you may get much more DOS RAM in which to work.

DATA RECOVERY

PC Tools includes a new automated program that prepares a more extensive emergency-recovery disk than Norton gives you, complete with hard disk drivers and a full set of recovery tools.

PC Tools' DiskFix digs deeper into your disk's directory structure than Norton's Disk Doctor, but the initial release digs a bit too deep. It falsely reported partition table errors on at least two machines that had nothing wrong with them, but sensibly warned us not to fix the error unless we were having trouble accessing files.

DiskFix got dangerously confused by a rare but benign error on another system, where the directory entry for one subdirectory listed a size of 2,048 bytes instead of the normal zero size. Neither CHKDSK nor Norton picked up on the error, which in fact is not dangerous at all. But DiskFix thought it detected lost clusters and cross-linked files—and then proceeded to trash the directory. The undo option restored the disk, and a corrected version of the program should be ready by now.

PC Tools continues to include an impressive variety of calculators, a simple database that creates dBASE-compatible files, and a scheduler that runs any DOS or Windows application.

Installation is more customizable than ever before, and the optional modifications that the program makes so that you can use its TSRs under Windows are now marked by comments in SYSTEM.INI. On our test system, program installation altered the default Windows color scheme.

This new version restores most of the confidence that Central Point lost with its bug-infested Version 7. The package increases PC Tools' already enormous appeal to beginners and intermediate users, and, for the first time, includes programs that many advanced users will add to their toolkits. So many well-designed utilities at such an economical price add up to a triumph of programming and design. □

FIRST LOOKS PLUS

To download a working demo of PC Tools from PC MagNet, type GO ZNT:DEMOS from any CompuServe prompt. From December 14 through December 18, you can go online to discuss PC Tools with Edward Mendelson and PC Tools product managers. Type GO ZNT:EXEC.

FACT FILE

PC Tools, Version 8.0
Central Point Software, 15220 NW Greenbrier Pkwy., #200, Beaverton, OR 97006, 800-445-4208, 503-690-8090; fax, 503-690-8083

List price: $179, upgrade $69.95
Requires: 640K RAM, DOS 3.3 or later.
In short: Version 8.0 of the jam-packed PC Tools matures with advanced disk-editing tools and a much more consistent interface

429 ON READER SERVICE CARD

Printers

Canon Breaks New Ground with $549 Bubble Jet 200

BY ALFRED POOR

There is a new ink jet printer on the market that aims to knock the Hewlett-Packard DeskJet printers off the top of the heap. With its $549 list price and laser-like output, the new Canon Computer Systems' Bubble Jet 200 is bound to win over some converts from the HP camp.

The BJ-200 is whisper-quiet while printing, which makes it a pleasant neighbor for any computer. Even better, however, is its small footprint. Where the HP DeskJets require a space about 17 by 15 inches, the BJ-200 needs just 13.5 by 7.5 inches. While not as compact and transportable as some ink jets (like the HP DeskJet Portable), the AC-power–only unit does weigh just about 7 pounds, so it isn't much of a load to carry. And unlike the DeskJet Portable, all the paper handling options are included in the base price.

COMPACT: *The Canon Bubble Jet 200 weighs just 7 pounds.*

The paper feeds from a stack in the back of the printer; Canon rates the tray at a 100-sheet capacity. You can also use the same tray as a single-sheet, manual feed slot. The printer is also designed to handle envelopes, up to a standard #10 business envelope, which feeds wide-edge first so you don't need to hassle with landscape fonts. You can even stack up to ten envelopes in the paper tray. We had no misfeeds during our tests.

The printer is easy to set up and install. The one-piece ink cartridge slips into place smoothly and is locked in by a retaining handle. There are 12 DIP switches allowing you to choose between Bubble Jet and Epson LQ emulation modes. Most users will leave these switches at their factory default settings, but in case you ever need to change them and happen to misplace the manuals, the settings are all clearly documented inside the printer housing lid. There are a number of useful self-test printouts to help you check out the printer.

NEW PRINTHEAD

The ink cartridge includes the ink jet printhead, which uses a new 64-nozzle design. This enables the printer to produce remarkably fine resolution output (up to 360 dots per inch). Print samples on plain photocopier paper not only rival the best output from other ink jet printers, but many users will be hard-pressed to see any difference between this and laser-printed pages without resorting to a magnifying glass.

The ink cartridges are rated for 1.4 million characters in high-speed mode and half that (700,000 characters) in either of the quality modes. At about 2,000 characters per double-spaced page of text, this works out to 350 pages in quality mode. The cartridges list for $25 apiece, so $0.07 per page is a good estimate for the per-page ink costs (half that in draft mode).

The BJ-200 has three different print modes: high-speed, high-quality, and super-high-quality. The third is slower than the first two but is also even quieter. Canon rates the high-speed mode as about 50 percent faster than high-quality mode, though that was not borne out in our text-speed tests. Both modes turned out about 3.2 pages per minute (slightly faster than the DeskJet draft mode, and about a page per minute faster than the DeskJet final-quality mode). With the super high-quality mode, the BJ-200 slowed down to about 2.2 pages per minute, about the same as the DeskJet quality mode.

LIGHT ON FONTS

The printer is a little light in terms of fonts. It only has Prestige and Courier in Bubble Jet mode and adds Sans Serif, Roman, Script, and Orator in the letter-quality mode. The printer comes with drivers for both Microsoft Windows 3.0 and 3.1 and works well with Windows 3.1 TrueType fonts, so Windows users will be able to take advantage of scalable, proportional fonts without adding any options.

The printer comes with a pair of well-written and thoroughly illustrated manuals, and they include a list of the printer Escape sequence commands.

The BJ-200 costs less, prints faster, and takes up less space than the DeskJets it has targeted as its competition. It is an extremely attractive solution—even for those who are considering a 4-page-per- minute laser printer—and deserves to be a big success. □

BJ-200 SUPER HIGH QUALITY
Our wretched species is so made th
walk on the well-trodden path alwa
at those who are showing a new roa
Normal Bold Condensed

BJ-200 HIGH QUALITY
Our wretched species is so made th
walk on the well-trodden path alwa
at those who are showing a new roa
Normal Bold Condensed

BJ-200 HIGH SPEED
Our wretched species is so made th
walk on the well-trodden path alwa
at those who are showing a new roa
Normal Bold Condensed

TEXT OUTPUT: *Print samples from the BJ-200.*

FACT FILE

Bubble Jet 200
Canon Computer Systems Inc., 123 East Paularino Ave., P.O. Box 5048, Costa Mesa, CA 92628; 800-848-4123, 714-438-3000; fax, 714-438-3099

List price: $549
Requires: parallel port and cable.
In short: Canon's latest printer features new ink jet technology that produces stunning output faster than the Hewlett-Packard models with which it competes

(427) ON READER SERVICE CARD

IN A RECENT INDEPENDENT STUDY,

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*Survey conducted by Peripheral Strategies, Inc., an independent research firm. Survey results taken from 9/92 study of 214 users of both Fastback and Central Point Backup. Survey results statistically accurate at a 95% confidence level with a sample error of ± .068

CIRCLE 079 ON READER SERVICE CARD

Special Report

Vendors Rush to Connect To Windows for Workgroups

BY DON WILLMOTT

Bill Gates isn't the only one who thinks Microsoft Windows for Workgroups has potential ("Windows for Workgroups," *PC Magazine*, December 8, 1992). At the product's late-October introduction, dozens of hardware and software vendors announced plans to bundle in or take advantage of the new peer-to-peer network functionality that Windows for Workgroups offers. Here's a summary of some of those plans.

On the systems side, eight PC vendors have announced specific Windows for Workgroups deals. **AST Research** has introduced two network-ready systems, the Bravo 4/25s Model 123G and the 4/66d Model 213G. Both have integrated Ethernet and are bundled with Windows for Workgroups. (800-876-4278, 714-727-4141.)

CompuAdd will offer the operating environment for $50, preloaded on all the systems it sells with network cards. For current Windows users, CompuAdd will sell two add-in kits. One, with software and a network board, will cost $194.99. The other, consisting of software only, will cost $65.99. (800-456-3116.)

Gateway 2000 will sell Windows for Workgroups as an option. Users who order it will get the software and a network adapter preinstalled and configured. (800-523-2000, 605-232-2000.)

NCR will begin shipping its System 3000 PCs as a preloaded option before the end of the year. A software upgrade for current System 3000 Windows users will also be available. (513-445-5000.)

Northgate, which already has a big business in selling networking solutions, will add Windows for Workgroups to its product line as an option. (612-943-8181.)

Packard Bell is introducing a new system in conjunction with the new environment. The 486SX/25 Network Ready Workstation includes an Ethernet Card and Microsoft's Schedule+ group calendaring program along with Windows for Workgroups. (818-886-4600.)

Wyse Technology has unveiled four new network-ready systems that include integrated Ethernet and Windows for Workgroups. The company's 486si models are available in 33-MHz 486DX, 50-MHz 486DX2, and 66-MHz 486DX2 configurations. A 25-MHz 386SX system is also available. (408-473-1200.)

Zenith Data Systems has begun installing Windows for Workgroups on its network-ready Z-Station desktop and Z-Note notebook systems. (800-553-0331.)

SOFTWARE

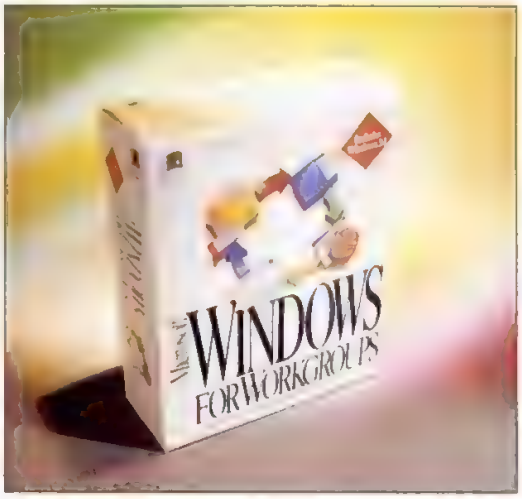
Action+Plus for Microsoft Windows for Workgroups extends the contact-management, scheduling, and time-management features of Action+Plus, Version 5.0, across the network. It sells for $399.95. (Action Plus Software Inc., 800-766-7229, 801-255-0600.)

Ascend, a personal information manager based on the Franklin Day Planner, adds contact-management facilities to its new Windows for Workgroups version. The calendar feature integrates with Schedule+ as well. (Franklin Quest Co., 800-877-1814, 801-975-9992.)

In the CAD department, **CADvance for Windows** has implemented Windows for Workgroups mail functions so that you needn't leave the CAD program to send network e-mail messages. (ISICAD Inc., 714-533-8910.)

Future versions of **FAX-Grabber** will automatically convert incoming fax images into text and deliver them to a Windows for Workgroups mailbox. (Calera Recognition Systems Inc., 800-544-7051, 408-720-8300.)

JetForm for E-Mail, Version 3.1, will use the built-in electronic mail features of Windows for Workgroups to make routing forms through an office easier. (JetForm Corp., 800-267-9976, 613-594-3026.)



TYING IN: *Windows for Workgroups has a following.*

Lightship, a visual information and analysis system, will also take advantage of Windows for Workgroups e-mail by letting users send Lightship screens and reports to one another across the LAN. An updated version designed around the new environment will appear in mid-1993. (Pilot Software Inc., 617-350-7035.)

Media Organizer for Workgroups will let users send messages that include video, sound, graphics, and animation across the LAN using Windows for Workgroups. (Lenel Systems International Inc., 716-248-9720.)

The $179 **Norton Desktop for Windows** has added support for Windows for Workgroups. Users can drag and drop a file to the new Mail tool and send it without opening the related application. (Symantec Corp., 800-441-7234, 408-252-3570.)

Ventana TeamGraphics uses Windows for Workgroups to facilitate meetings, whether they are face-to-face or remotely conducted. This groupware collaborator, available by the end of the year, will cost from $200 to $500 per user. (Ventana Corp., 602-325-8228.)

With **WinBEEP** you can send a message to an alphanumeric display pager from any Windows system with a modem. Network DDE (Dynamic Data Exchange) and Windows for Workgroups will let users who aren't equipped with a modem use one remotely across the LAN to contact a pager. (Fourth Wave Technologies Inc., 313-362-2288.)

WinRules is a collection of rules-based tools designed to help Microsoft Mail and Schedule+ users manage mailboxes and build mail-based workgroup applications. Available early in 1993, it will cost $99.95 per user. (Beyond Inc., 617-621-0095.)

XTree for Windows will be upgraded in February to support Windows for Workgroups. With the new version, users will be able to send files as message attachments across the LAN and make their drives easily accessible by other users of the LAN. (XTree Co., 800-333-6561, 805-541-0604.) □

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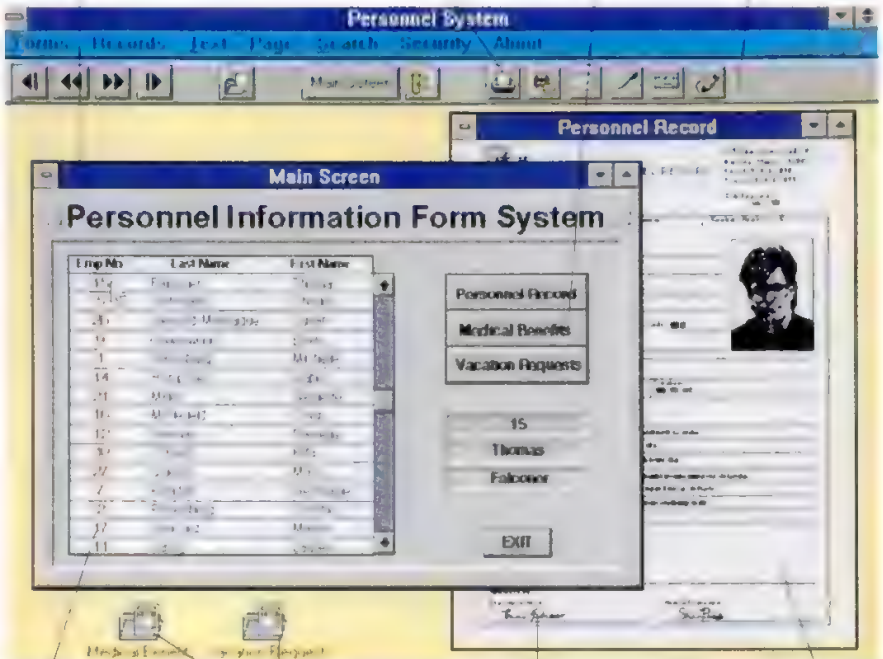

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Notebook PCs

Screen Gem: IBM Comes Up With a Notebook Winner

BY MATHEW J. ROSS

One of the first fruits of IBM's recently launched IBM Personal Computer Co. is a superb 7.6-pound, $4,350 color notebook: the IBM ThinkPad 700C. To those familiar with IBM's checkered past in the portable market, this notebook is a bold step and a great success.

The ThinkPad we tested came equipped with 8MB RAM, a 120MB hard disk, and OS/2 2.0 for $4,350; a 4MB DOS version sells for approximately $300 less. The impressive design work inside the ThinkPad may have you wondering who is actually responsible for this impressive 2.25- by 11.5- by 8.25-inch (HWD) color notebook.

The answer is IBM. At the heart of the system are three IBM-developed technologies that set the ThinkPad apart from the competition: a large active-matrix color display from Display Technologies (the IBM Japan/Toshiba joint venture), IBM's own 25-MHz 486SLC processor, and its integrated TrackPoint II pointing device.

The first thing you'll notice about the ThinkPad is the color display. IBM boasts that at 10.4 inches diagonally, the DTI panel is currently the largest available on the market. The panel is bright and vivid, excellent for presentations with its wide viewing angles, and it features sliding contrast and brightness controls. But IBM is offering more than just good looks here. Its excellent 3.32 Graphics Winmark score outpaces the $3,999 Toshiba T4400SXC with its 8.5-inch display and score of 2.9 megapixels per second (that system has been renamed the T4400C and now has a 9.5-inch screen).

Next, you'll probably notice the small red widget rising up from the center of the keyboard. Called the TrackPoint II, it is to date the most unobtrusive and user-friendly pointing device in the notebook industry. A small, rubber-capped joystick resembling a pencil eraser that's neatly wedged between the G and H keys, the TrackPoint is used in tandem with two buttons that rest beneath the Spacebar.

What makes the TrackPoint so attractive is its ease of use. Equally comfortable for lefties and righties, the pressure-sensitive TrackPoint lets you move the cursor slowly or quickly with your index finger while you keep both hands in the typing position.

Inside, IBM's own 486SLC provides competitive performance. The IBM-built 486SX processor runs at 25 MHz and adds a 16K internal cache to a CPU design largely developed by, and licensed from, Intel. On our tests, the ThinkPad showed itself to be a workhorse, with above average CPU and memory performance, and IBM has announced support for a clock-doubling 50-MHz CPU upgrade to follow.

Four megabytes of memory are built into the system, with two memory card slots for added expansion. The system we tested had one 4MB card added, for a total of 8MB RAM. Unfortunately, IBM uses the 88-pin JEIDA standard also used in its CL57SX, not the PCMCIA standard currently gaining momentum on notebooks.

DAZZLER: *The ThinkPad 700C has a 10.4-inch screen.*

While it doesn't accomodate PCMCIA options, the ThinkPad does include an internal modem slot, which also accepts a second serial board in addition to the serial, parallel, VGA, and mouse ports in the system.

Additional flexibility comes from the removable 120MB, 2.5-inch IBM hard disk. Described by IBM as employing a proprietary interface similar to IDE called *direct bus attached*, this 17-ms IBM unit was a competent performer on our tests.

Release the black plastic cover and pull on the small handle, and the hard disk quickly pulls out from the front of the ThinkPad. The removable disk facilitates the sharing of units among coworkers, while at the same time providing a high level of data security. A 120MB hard disk is available for $695.

POWER CONSERVATION

Also removable is the nickel hydride battery that sits just below the Spacebar. An internal bridge battery allows you to change batteries on the fly after placing the unit into standby/resume mode, which works under DOS, Windows, and OS/2.

With power-saving enabled, the ThinkPad senses a low-battery condition and automatically forces itself into standby. The bridge battery will preserve unsaved data for up to 5 hours.

The system ran for as long as 3 hours in normal use, and we measured 1 hour 59 minutes on PC Labs' worst-case Battery Rundown test, as compared to 2 hours 26 minutes for the slightly heavier (7.8-pound) Toshiba T4400SXC.

After years of designing undistinguished portables, IBM has finally gotten it right.

• List price: *IBM ThinkPad 700C, with 4MB RAM, 120MB removable hard disk, TrackPoint II integrated pointing device, DOS 5.0, $4,050; IBM Personal Computer Co., Route 100, Bldg. 3, Somers, NY 10589; 800-772-2227, 914-766-1900.*

Circle 430 on reader service card

Benchmark Tests: IBM ThinkPad 700C

The IBM ThinkPad 700C achieved an outstanding Graphics Winmark score, outpacing even the excellent Toshiba T4400SXC, whose scores are included here for comparison.

We used PC Magazine Labs' Hardware Performance Tests, Release 7.0, to measure each PC's processor, memory, video, and disk subsystem performance. The Graphics Winmark is the mean of 12 Windows-based graphics tests.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	Graphics Winmark (megapixels per second)
Toshiba T4400SXC (25-MHz 486SX active-matrix color)	6,560	4,354	20	3,089	1.75
IBM ThinkPad 700C (25-MHz 486SLC active-matrix color)	4,364	2,991	20	4,014	3.32

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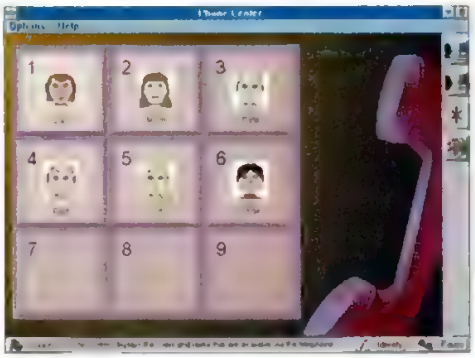
CIRCLE 148 ON READER SERVICE CARD

Tandy's Sensation: A System for the Multimedia Family

BY BRUCE BROWN

You can upgrade a PC to make it multimedia-ready, but if you're willing to pay a little more for a preconfigured multimedia machine, the Tandy Sensation is worth a look.

The $1,999 Sensation (complete except for a monitor) is not a high-end, killer system. It's designed to appeal to small businesses, home office workers, and families. Built around an Intel 25-MHz 486SX processor, Tandy equips the Sensation with 4MB of RAM (expandable to 32MB), a 107MB hard disk, a 1.44MB floppy drive, and a CD-ROM drive that uses a caddyless pullout carrier and is rated at 375-millisecond average access and 150K throughput. There's no room for additional drives, and Tandy does not offer a larger hard disk.



IT'S FOR YOU: *Included software lets every family member have a message box.*

The Sensation's standard video setup includes a 16 million–color Tandy Multimedia Palette Chip, a Western Digital WS903C1-ZS Windows Accelerator, and 512K of VRAM for 256-color 640-by-480 resolution; 16-color 800-by-600 mode; or 16-color 1,024-by-768 mode. Our test system came with a $399 Tandy 14-inch VGA monitor. Also available is a $329 PC/TV board, a 122-channel cable-ready board that plugs into one of the Sensation's three free horizontal ISA expansion slots to allow you to see high-resolution 720-by-480 television signals on the monitor.

The Sensation's built-in speaker works with a 12-bit analog-to-digital and digital-to-analog converter and FM synthesizer for sound effects, computer generated voice effects, and music. Volume control buttons, the microphone jack, and the headphone jack are all on the case front.

The sound that comes from the Sensation's internal speaker isn't bad, but you'll want to add a set of amplified external speakers that you can plug into the back of the case. Tandy sells a matching $99.95 amplifier/speaker combination that sits on top of the system case and under the monitor.

Ports on the back of the system include PS/2 keyboard and mouse ports, one serial port, one parallel port, a 15-pin game port, a 15-pin video out port, a MIDI port, and two RJ-11 ports for the system's standard internal fax modem.

The modem has 4,800 bits-per-second fax send capability, and with its DTMF (digital tones multiple frequencies) circuitry, it can be used for a voice mail system.

MULTIMEDIA READY: *The $1,999 Tandy Sensation makes multimedia fun.*

As with many multimedia systems, the Sensation comes with a pile of software. In addition to DOS 5.0, you get Multimedia versions of Microsoft Windows 3.1 and Microsoft Works for Windows, Microsoft Bookshelf for Windows, and Tandy's WinMate Windows organizer. For those who dial out for information and fun, Tandy includes software for America Online, Prodigy, and The Sierra Network.

SOFTWARE FOR THE FAMILY

WinMate, the key to the Sensation, is a proprietary multimedia front end used to navigate the applications that come standard with the Sensation. Winmate's graphical screens and sounds help you choose which category of software to work (or play) with. The categories—In Touch, In the Know, In the Bank, In Control, In Charge, In Play, In Print, and Inside—each have icons to represent them. The system provides help with a realistic voice and fun sound effects.

The Sensation's most intriguing software is the family-oriented message center and voice mail system. Each family member can have a password-protected message box and voice mail box, including an individual icon created with a face-drawing utility, clip art, or a graphics program.

Family members who want to leave messages for everyone or for specific individuals can use a microphone for a sound message or type in text. When you retrieve a message, you can have the computer either read a text message to you or play back a recorded message. You can also assign up to nine voice mailboxes that callers can access by following verbal instructions and using touch tones. The voice mail system includes a remote access feature.

Other software that will appeal to family members includes a selection of multimedia educational games; a cookbook; budgeting and checkbook applications; a collection database; a print utility for creating banners, notices, cards, and name tags; a travel planner; a graphics utility with clip art; and an AT&T toll-free number directory. The CD-ROM's slow retrieval speed is particularly noticeable with that directory.

Clearly, the Sensation is no speed demon. But for families just getting started with computers or for home office users who can use the voice mail features, the Sensation is a nicely packaged system with plenty of software to keep everyone entertained and occupied. □

FACT FILE

Tandy Sensation
Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011

List price: $1,999 with 4MB RAM, 107MB hard disk, 375-ms CD-ROM drive, MultiMedia Palette video chip, 2400/4800 bps data/send fax modem, mouse, DOS 5.0, Microsoft Windows 3.1, PC/TV add-in board, $329, MMS-10 speaker/amplifier system, $99.95; Tandy VGM-441 monitor, $499.95.

In short: Tandy's Sensation is a well-integrated bundle of moderately powerful hardware and some intriguing software installed and configured to make multimedia computing accessible to less-than-expert users.

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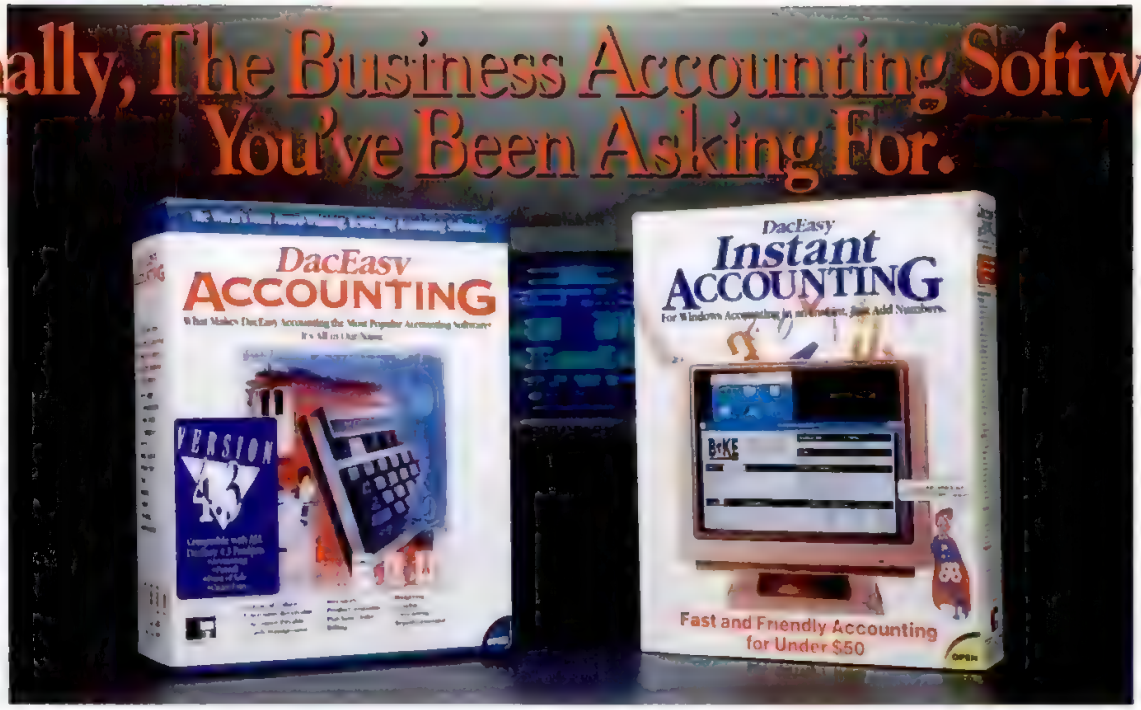

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CIRCLE 243 ON READER SERVICE CARD

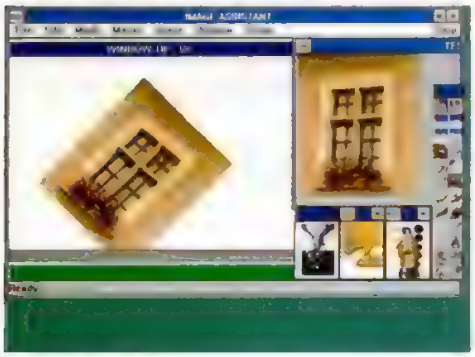
■Imaging Editing

Image Assistant: Innovations and Limitations

BY BARRY SIMON

Interesting innovations with rough edges and limited functionality. That's the story of Caere Corp.'s $495 Image Assistant, a Microsoft Windows-based image-editing program with a dual-mode interface.

You can choose the way you want the program to look: either as a standard image editor with a crowded toolbox; or in Assist Mode, with a friendlier box of ten labeled buttons. Two of those buttons are Undo and Redo, and they make Image Assistant stand out. You get unlimited multilevel undo capability.



MANIPULATION: *Automated scanning adjustments work on already-scanned images.*

With 10MB of hard disk space free, we were able to undo six to eight times during our testing.

Four other buttons—Adjust Tone, Adjust Color, Sharpen/Smooth, and Special Effects—highlight another of Image Assistant's new user-interface devices: choosing by example. For instance, Sharpen/Smooth brings up a thumbnail of the original with ten samples at full size of how a section of the picture will look at different degrees of global smoothness and sharpness. You can just pick the one you want rather than having to guess at cryptic settings.

Choosing by example is also used during printing. You can print out a sample sheet with examples of different printing adjustments to help you decide which setting you want for the full printout. It's a handy method that will surely be widely imitated.

The other four buttons bring up mini-toolboxes for painting, selection, enhanced detail and text annotation.

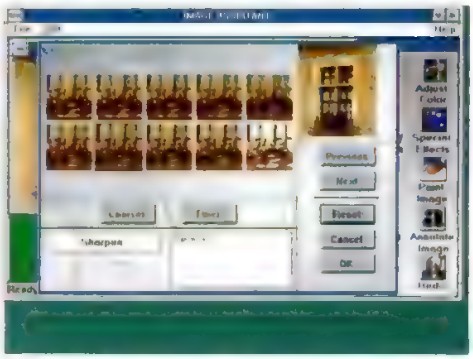
SCANNING EXPERTISE

Another area where Image Assistant pushes the boundaries of image editors is in its scanning abilities. Caere trades on the expertise it developed with its industry-leading OmniPage OCR package. The program attempts to separate text from pictures during a scan and save only the pictures. It will also rotate a scan if it isn't vertical. These features are also available for post processing an on-disk photo. Image Assistant isn't as strong in its scanning as a specialized program like Light-Source's Ofoto, but its scanning stands out among image editors.

Other special features of the package include support for images in Macintosh formats (MacPaint and PICT) and Scitex CT. Image Assistant currently is the only program that allows you to edit in CYMK mode with the bit planes both combined and separated.

AMBITIOUS AND AWKWARD

While innovative, Image Assistant is a combination of the ambitious and the awkward, with unexpected limitations in areas you'd expect a $500 image editor to master. A good example is color. You can choose colors from an HSV color wheel, a palette, a Pantone matching system, a color picker, and a unique color blender. But the interface is confusing. The color wheel works only to pick foreground colors, not background. The color wheel comes up in grayscale mode but has no effect there either. It's only accessible via button, not through the menus, while the palette is only accessible via a menu.



WHICH ONE? *Assist mode gives you thumbnails showing the effect of your choices.*

Another example is the instant feedback you get when you make various choices in dialog boxes—something that is often a virtue. In some dialogs, you'll move the R part of RGB sliders and then grit your teeth at the hourglass that pops up, preventing you from getting to the second slider.

Masking abilities are also a mixed bag. There are rectangle, ellipse, polygon, and freehand selection tools together with a magic wand and a color mask option. The color mask is set via RGB sliders, not by clicking on colors on the screen, so it's difficult to use. You can save masks in TIFF format.

You can only see your selections on-screen in a mode that places a partly opaque wash over the unselected (masked) area. So while you can select additional regions with Shift-click, it is very difficult to see what you are picking.

Other glitches: the SaveAs dialog doesn't allow you to change directory unless you type in the full path name by hand. There's no on-screen text to tell you what the toolbox icons are. And there's no way to change magnification except by a factor of two for each click.

The Image Assistant package includes a clone brush, but it only works with a single image, not between two of them. There are no drawing tools, not even a rectangle.

LOTS OF COMPETITION

Image editing is very competitive these days, with many excellent products, notably ZSoft's PhotoFinish and Micrografx's PhotoMagic priced below $200, and Aldus' PhotoStyler and Micrografx's Picture Publisher at the high end. Adobe's PhotoShop, long a Macintosh superstar, is on its way to Windows and could define a new high end. This version of Image Assistant, while full of innovations, just doesn't bring enough to the party to be competitive with the many strengths of these other products. □

FACT FILE

Image Assistant, Version 1.0

Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226, 408-395-7000; fax, 408-354-2743

List price: $495

Requires: 5MB RAM, 8MB hard disk space, Microsoft Windows 3.1

In short: While Image Assistant includes many clever image editing interface ideas, some are not ideally implemented. Other packages in this price range are better

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Animation

AddImpact!: An Easier Way to Embed Sound And Motion into Your Files

BY STEVEN ROSENTHAL

You're ready to punch up your presentations and on-screen documents with sound and motion. You'd like to distribute those documents to coworkers or customers as disk files or over a network. But you don't want to trade in your familiar Microsoft Windows applications for a completely new multimedia environment.

You're a prime candidate for Gold Disk's new $129 AddImpact!. This multimedia sound and motion package is configured as an OLE (Object Linking and Embedding) server that you can call up from within cooperating Windows applications. Once you've installed the package, picking "edit object" or a similar command from your application's normal menu brings up an AddImpact! window that lets you add 256-color moving graphics, dynamic text effects, simple path-based animations, narration, and music to your documents.

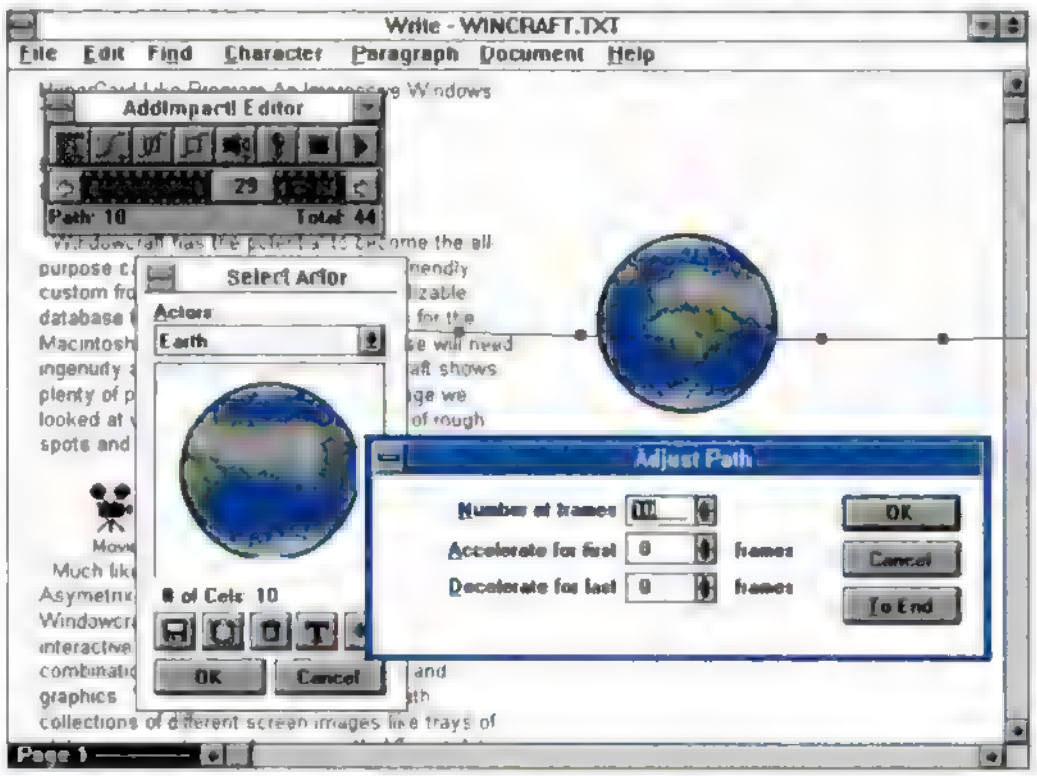
With some product-by-product limitations and quirks, the program works with Ami Pro, Excel, Microsoft Word and PowerPoint, Windows Write, or any other program that can act as an OLE client.

The process works best for simple business graphics, such as charts with bars that change to show year-by-year results or spinning corporate logos with musical backup. But if you're really dedicated, you can create lavish layered productions with large numbers of moving objects presented over a background image or gradient, all synchronized to music and narration.

As an animation package, AddImpact! resembles a limited form of Gold Disk's standalone Animation Works Interactive (AWI) program. You create "movies" by choosing one or more bitmapped images for "actors," then give them motion paths and optional rotations, inversions or size changes.

AddImpact! lets you create your own text blocks as actors from within the program, but all other images have to be imported or selected from the nearly seven megabytes of images, movies, and sounds included in the package.

If your system supports a multimedia-compatible sound driver, AddImpact! will let you attach a MIDI or .WAV audio file to any frame in your movie. But you can't layer simultaneous sound files together, and you can only record narration if you have the right hardware and drivers for audio input.



PATH: *Send your animation spinning across the screen.*

As with other OLE servers, you can include the complete multimedia object within your document by embedding it, or include only a pointer to the object by linking it. Gold Disk recommends that you embed the object and the provided player-only AddImpact! module when you are creating a document for distribution.

If you're one of the many Windows users who's found an application where you're already at home, AddImpact! will let you upgrade your documents and distribute the results without abandoning your current working environment.

• List price: *AddImpact!, Version 1.0, $129.* Requires: *2MB RAM, 4MB hard disk space, Microsoft Windows 3.1. Gold Disk Inc., 5155 Spectrum Way, Unit 5, Missisauga, Ontario, Canada, L4W 5A1; 800-465-3375, 416-602-4000; fax, 416-602-4001.*

Circle 415 on reader service card

Hard Disks

Conner Offers Hard Disks With Preloaded Software

BY JAMES KARNEY

Conner Peripherals' new Sof-Stor kit lets users and resellers add a hard disk and software to an ISA-compatible PC system with minimum fuss. The package, which comes in 85MB ($599) and 170MB ($699) versions, includes a preformatted Jaguar series IDE 17-ms drive with a Host Bus Adapter (HBA) interface card loaded with DOS 5.1, Microsoft Windows 3.1, Works for Windows 2.0, and Central Point Software's Anti-Virus for Windows 1.0. Trial versions of Microsoft Money and Publisher are also provided.

The hardware installation is straightforward. Just open the computer, put the HBA card in a free slot, mount the drive in a bay, attach the power and data cables, then close the system. We found the default settings worked perfectly in a 386-based unit with an existing MFM hard disk and controller. The same was true when the MFM hard disk was removed and deleted from CMOS. With that configuration, the Conner hard disk booted the machine perfectly.

We did have some problems when trying to install the drive in a 486-based machine with a high-capacity ESDI hard disk already on the system. The manual is a bit sparse and doesn't explain the jumper settings, but the technician at Conner's toll-free number was able to help us get things going.

There are some definite advantages to the Sof-Stor bundle. The street price of the package is about $100 less than the cost of buying the components separately, and you'll save about 2 or 3 hours of formatting the disk and loading the software. The only potential drawback is that no floppy disk controller is included, so you have to make sure you're equipped for that elsewhere. Sof-Stor is a good buy if you don't already have the bundled software, and if you want to save time and hassles when installing an IDE hard disk.

• List price: *Conner Sof-Stor, 85MB version, $599; 170MB version, $699.* Requires: *ISA-based PC, one free expansion slot. Conner Peripherals, 3081 Zanker Rd., San Jose, CA 95134; 800-543-3310, 408-456-4500; fax, 408-456-4902.*

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Hard Disks

Arco Card Gives PS/2s Sorely Needed Disk Expansion

BY WINN L. ROSCH

The Arco Electronics AC-1079MC is more than just a hard disk card; this full-length Micro Channel expansion board is an extraordinary mass-storage interface. It gives PS/2s all the drive options of other PCs without imposing performance limits of its own. The downside: its novel technology has a relatively high price of $395.

The AC-1079MC does the almost-impossible: It links AT Attachment IDE hard disks to the Micro Channel bus. Ordinarily the two standards are incompatible, but Arco has made a perfect match using a clever BIOS that works with DOS, OS/2, NetWare and Unix with no need for software drivers.

As with other IDE host adapters, the AC-1079MC handles one or two drives, but the board allows more options in both installing and controlling drives. It has predrilled holes for mounting one or two 2.5-inch (not 3.5-inch) hard disks so you can make your own dual-disk card. A 44-pin header lets you run an ordinary IDE cable to bay-mounted internal drives. Or you can plug external drives into a connector on the retaining bracket of the AC-1079MC. Within the two-drive limit, you can mix on-board, internal, and external drives.

When using two identical drives, the AC-1079MC lets you choose RAID 1 hardware-drive mirroring. Disk writes are synchronized so both drives store the same data, one backing up the other.

Performance is constrained more by drives and the host computer than the AC-1079MC itself. Raw throughput measured over 1MB per second with a Seagate ST9096A disk (Arco claims a limit of 1.2MB/sec). System overhead in the PS/2 Model 60 used for testing dropped its benchmark transfer rate to 406.7K per second.

MIRRORING: *The Arco card has room for two hard disks.*

Arco includes two cables for mounting drives on the board and offers a $40 cable to connect external IDE drives, as well as three hardware kits for internal mounting of drives. Clever but expensive, the AC-1079-MC gives MCA computers drive expansion abilities they sorely lack.

• List price: *Arco AC-1079MC, $395; external drive cable, $40; Arco hardware kit, $20. Arco Electronics Inc., 5830 Sheridan St., Hollywood, FL; 800-458-1666, 305-961-1666; fax, 305-964-1984.*

Circle 417 on reader service card

Databases

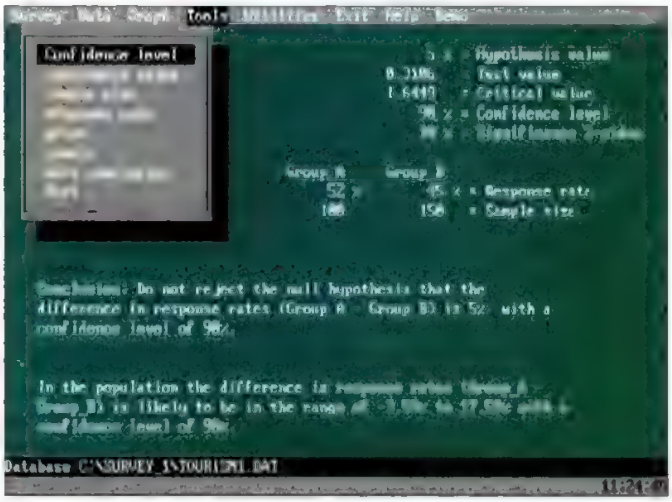
SurveyFirst: Small Data Manager Includes Serious Analysis Tools

BY SHERYL CANTER

Priced at $195, SurveyFirst is a stripped-down version of Raosoft's Survey, a unique $495 package comprised of a questionnaire builder, a data entry system, a set of database management tools, and—most impressively—a menu-driven statistical analysis module that makes it all seem easy. While Survey can handle any number of records, limited only by hardware, SurveyFirst can store a maximum of only 1,000 records. That's small for most business purposes, but it's certainly an improvement over the old limit of 150. (It was originally sold as a teaching tool.)

SurveyFirst uses an interface of pull-down and pop-up menus to give you access to its various modules. To design a questionnaire, use the built-in editor. It's obvious you're running a DOS program; questionnaire design is command-driven. However, the commands are simple, and the documentation is outstanding. Once you have defined the structure of your questionnaire, data entry screens and distributable hard copy versions can be created automatically.

After you have designed your questionnaire, you can create the database that goes with it. Data is stored in dBASE III format, and any dBASE III file can be used. You can also import ASCII and .WK1 files. If you're importing a preexisting file, you'll still have to manually define the questionnaire to go with it—there's no automatic form generation.



HYPOTHESIS TEST: *SurveyFirst builds and analyzes questionnaires.*

The best part of SurveyFirst is its statistical analysis module. You will not find another package that makes it so easy for the untrained user to discover statistically significant trends. Just about everything you need for analysis is included—means, standard deviations, t-tests, chi-squares, simple correlation and regression, and more.

In addition to cross-tabulation tables and descriptive statistics, you can also generate bar and pie charts. A built-in report writer lets you customize your report.

SurveyFirst is a unique product with an unusual array of capabilities, but it's hard to recommend for serious use because of its 1,000-record limit. It's still an excellent teaching tool, but if you need a serious tool for analyzing market test data or customer surveys, stick to the full-featured product, Survey.

• List price: *SurveyFirst, Version 2.0, $195.* Requires: *512K RAM, DOS 2.0 or later. Raosoft Inc., 6645 N.E. Windermere Rd., Seattle, WA 98115; 206-525-4025; fax, 206-525-4947.*

Circle 421 on reader service card

Personal Finance

Microsoft Money 2.0: Improvements Help, But Quicken Still Leads

BY PETER SCISCO

Toward the end of every year, thousands of PC users make a resolution to start managing their personal finances electronically. The $69.95 Microsoft Money, now updated to Version 2.0, is one good solution.

In features, Money 2.0 compares with market leader Quicken (and in particular, Quicken 2.0 for Windows). The program manages essential financial information for home and small business use. Anyone who has written a check, scribbled a budget, or attempted to balance a bank account will grasp the program's basics in short order.

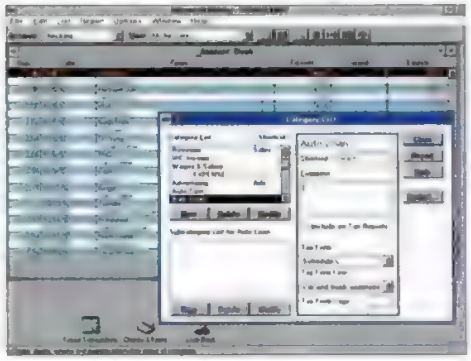
Like Quicken 2.0 for Windows, Money 2.0 keeps track of transactions and links those transactions to user-defined or predesigned categories. You can enter transactions by filling in a register or a facsimile of a check, which can be printed.

The heart of any financial program is its reporting features. Money 2.0 makes it painless to create reports for budgets, taxes, and loans. You can design custom reports and refine them according to categories, time periods, and the like. The Tax Form and Tax Report are especially well designed. As in Quicken, each transaction can be assigned to a specific line of a specific tax form. When tax time comes, you simply print a tax report, and Money automatically breaks down the transactions to the separate lines on the tax forms. With information like this, your accountant should give you a discount.

Money 2.0 and Quicken both export to formats compatible with tax prep packages.

While Money 2.0 boasts superior tax-reporting features, it trails Quicken in the use of graphs and charts. Reporting functions are roughly equivalent to those available in Quicken, but visual feedback and interactive design are much stronger in the Intuit program.

In Quicken, bar graphs and pie charts interact with the user and the underlying data. Double click on a bar, and Quicken creates a pie chart for the relevant data. Double-click on a slice of the pie for a view of relevant transactions. None of this interactivity is available in Money 2.0.



REGISTER: *Microsoft Money tracks expenses.*

Money 2.0 is sure to gain its share of devotees. It's a good-looking personal financial package and provides lots of useful tools for small businesses. But Quicken users who have moved to the Windows environment should go ahead and upgrade to Quicken for Windows.

• List price: *Microsoft Money, Version 2.0, $69.95.* Requires: *1MB RAM, Windows 3.0 or later. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.*

Circle 425 on reader service card

Multimedia PCs

AST PowerExec: Expansion Options Protect Your Investment

BY JULIE COHEN

AST Research has loaded its 6.3-pound, $2,795 PowerExec 3/25SL with every new and desirable feature a notebook could have. This system's upgradability and wide range of expansion options are designed to protect your investment.

AST built upgradability into the PowerExec. With its two easily accessible memory sockets, the PowerExec can hold up to 20MB of RAM. If you run out of disk space, pop in a new 60MB, 80MB, 120MB, or 160MB removable hard disk. And when you're ready for color, take a screwdriver and replace the streaky monochrome screen with an active-matrix color screen.

ALL THE TRIMMINGS: *AST's PowerExec.*

The PowerExec contains two PCMCIA Type 2 slots for easy expansion of the system's communication options. To fill them, AST sells four different cards: an Intel 2400-bits per second, MNP 5 modem; two data/fax modems; an Ethernet adapter, and an SCSI adapter. The modem cards require an external connector.

Our unit also came with AST's SmartPoint mini-trackball. Its position, in front of the keyboard, feels alright: better than behind the keyboard, but less comfortable than a standard mouse. The z, x, and arrow keys can double as mouse keys.

Performance testing shows the PowerExec's considerable video speed, but in text mode, the display is blotchy and streaky. The blotchy letters are caused by duplication of every fourth row of pixels— a technique used by the Western Digital video chip set to stretch the screen's usable viewing space and increase the size of the letters. Fortunately, Microsoft Windows generates its own fonts.

Battery life was 2 hours 38 minutes in our worst-case test and 3 hours 58 minutes in our real world ZDigit test. To improve battery performance, you can adjust the power-management features. The setup menu (accessible by typing Fn-F2) gives two options: maximize performance or maximize battery life.

The PowerExec shipped too late to run in this issue's cover story on portable PCs. Nevertheless, it offers as many options and as good a performance as many of the comparably priced notebook PCs in that story.

• List price: *AST PowerExec 3/25SL, with 4MB RAM, 64K processor RAM cache, 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, AST SmartPoint mouse, $2,795. AST Research Inc., 16215 Alton Pkwy., P.O. Box 19658, Irvine, CA 92713; 800-876-4278, 714-727-4141; fax, 714-727-9355.*

Circle 424 on reader service card

Borland's

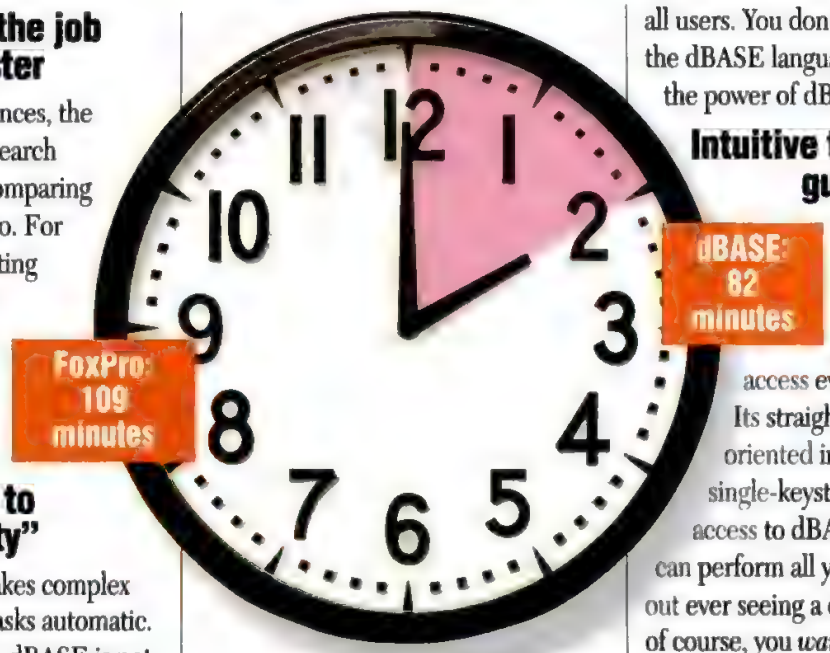
Get an extra 2 hours out

dBASE gets the job done faster

Recently, Usability Sciences, the leading productivity research firm, conducted tests comparing dBASE IV® with FoxPro. For everyday tasks like creating reports, browsing, linking, and using linked data, dBASE® users got their work done 25 percent faster.

The secret to "user-ability"

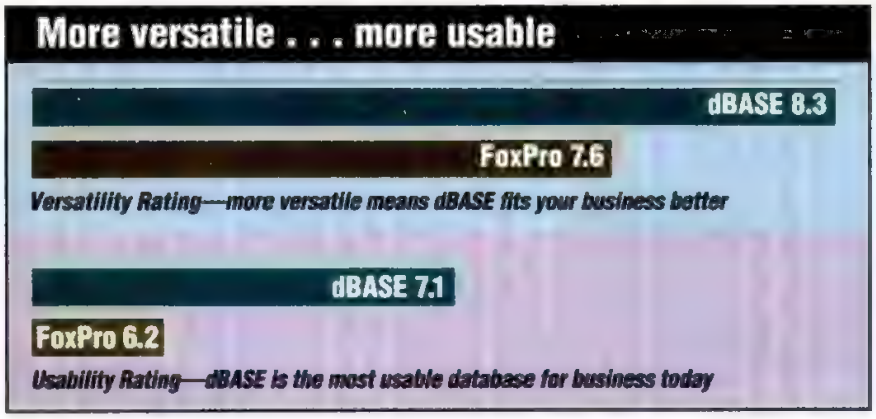
The Control Center makes complex tasks easy, and simple tasks automatic. Unlike the competition, dBASE is not merely a developer's tool. For those who *are* developing custom applications, the dBASE language sets the standard for power and productivity. But it's the dBASE Control Center that makes dBASE a favorite among all users. You don't have to learn the dBASE language before putting the power of dBASE to work for you.



dBASE takes less time to get the job done. *In independent tests using both dBASE and FoxPro, users got their work done 25 percent faster with dBASE. That's like getting an additional two hours of work done every business day. Now that's productivity!*

Intuitive tools eliminate guesswork

The dBASE Control Center puts you in charge, with the power to see and access everything at a glance. Its straightforward, task-oriented interface gives you single-keystroke or mouse-click access to dBASE's power. So you can perform all your daily tasks without ever seeing a dot prompt (unless, of course, you *want* to). And the Control Center's open architecture makes it easy to enhance or customize your own dBASE applications by incorporating third-party add-on products. No wonder NSTL rated dBASE tops in versatility and usability.* And why *ComputerWorld* ranked dBASE the #1 PC development tool for DBMS client/server software.



*NSTL found dBASE to be the favorite of both novice and experienced users alike in Overall Usability and Versatility.**

Get results fast

Powerful Design Tools let you create database tables, queries, data entry forms, reports, labels, and applications interactively. So you can see the results onscreen as you work.

Versatile Report Writer gives you the widest choice of report styles available, with many text enhancement features to add clarity to your data.

dBASE IV
of every business day!

I/S prefers doing business with dBASE

	Borland dBASE	Microsoft® FoxPro
Installed in Company	#1	#5
Best Technology	#1	#4
Best Price/Performance	#1	#3
Best Service/Support	#1	#5
Best Documentation	#1	#4
Prefer to Do Business With	#1	#4
Plan to Buy	#1	#4

Source: 1992 *ComputerWorld* I/S Brand Preference Study

*The latest **ComputerWorld** Preference Studies show dBASE outranks the competition in 12 out of 14 categories.*

Easy Label Designer includes formats for mailing labels, name badges, even Rolodex cards. You name it—you're only a few keystrokes or mouse clicks away from having it on your desk.

The world's #1 database keeps getting better

New dBASE IV comes complete with pull-down menus and mouse support, so you're never more than a click away from your data.

IQ!™ technology, dBASE's exclusive Index Query optimizer, finds the fastest way to get the answers you want from your database—automatically—even in the most complex network environments. Our relational Query By Example lets you manipulate your data quickly and easily. All you have to do is select the fields you want, and *presto*—instant results!

Fast new auto-install program practically installs dBASE by itself. It has never been easier to get started with a professional database.

Sophisticated tools for power developers

Power developers will like dBASE IV's 40 work areas, IBM® SAA-compliant SQL, plus many new functions and commands. The Template Language is now included free. We've enhanced BLANK support. And dBASE's automatically generated code can be combined with your own custom programming for unmatched speed and flexibility in creating new applications.

40 Different Work Areas • New Commands

Create applications easily

Even novice users can create custom solutions with dBASE. When you're finished designing your database tables, labels, and reports, tie them all together as a complete application with dBASE's easy-to-use Application Generator. And you do it all without programming! Keeping track of your data and putting it to work for you has never been easier.

Get your work done faster—get new dBASE IV today!

Whether you're a database user, MIS manager, applications developer, or even a CIO, it pays to standardize on the standard.

See your dealer today or call now, 1-800-331-0877, ext. 6497

In Canada, call 1-800-461-3327

Call now and we'll send you the fact-filled white paper on dBASE usability, *free*!

60-DAY GUARANTEE MONEY-BACK

BORLAND

Software Craftsmanship

*Software Digest Rating Report, Multiuser Database Programs, May 1992, Vol. 9, No. 2. Copyright © 1992 Borland International, Inc. All rights reserved. dBASE, dBASE IV, and IQ! are trademarks of Borland International, Inc. BI 4578

CIRCLE 285 ON READER SERVICE CARD

Business Forecasting

SmartForecasts: No-Nonsense Approach to Financial Prediction

BY THERESA W. CAREY

Business forecasting packages have long been plagued by poor interface design, and though Smart Software's $595 SmartForecasts, Version 3.0, doesn't break with that tradition, it does have a bevy of useful statistical bells and whistles. The ability to combine mathematical forecasting techniques and seat-of-the-pants estimation should be attractive to the marketing staff as well as to production managers.

Version 3.0 improves on the prior release (2.15) by letting you pick commands from menus rather than having to type them manually, and by upgrading the graphics capability from CGA to VGA. There is still a long way to go to make the program good-looking, but the implementations of the forecasting tools are very well done.

Other improvements include Box-Jenkins (ARIMA) forecasting, "eyeball" forecasting, and faster processing (SmartForecasts supports a math coprocessor if one is present).

Data entry is geared toward importing worksheet files (including multisheet .WK3 models), though you can enter data directly into a table or import ASCII files. Creating a variable is a simple process that lets you use various arithmetic and time series functions. For example, you could set up a cash flow variable that is some fraction of sales, lagged by a period or two. It also fills in missing values.

The heart of the program is its ability to decompose time series data and to fit a forecast to it. The Automatic feature runs a "tournament" to see which of five methods—single exponential smoothing, simple moving average, double exponential smoothing, linear moving average, or Winters' exponential smoothing—best fits the data. The program keeps you notified of its progress and then displays a graph of the best fit. The graph shows historical data, the curve generated by the method that won the tournament, and the forecasts, along with the forecasted margin of error.

SmartForecasts can analyze and forecast data in any periodicity—daily, weekly, monthly, quarterly, and so on—but it will prompt you for the data type whenever you go into analysis mode. It's not set up to convert data from one type (e.g. monthly) to another (e.g. quarterly) either.

Version 3.0 of SmartForecasts contains the tools that the professional business planner needs. The package would benefit greatly from a more attractive user interface and better graphics, but it's worth the investment for what it offers.

BEST FIT: *SmartForecasts can graph the time series components of your data.*

• List price: *SmartForecasts, Version 3.0, $595;* Requires: *512K RAM, 1.2MB hard disk space, DOS 3.0 or later. Smart Software Inc., 4 Hill Rd., Belmont, MA 02178; 800-762-7899, 617-489-2743; fax, 617-489-2748.*

Circle 420 on reader service card

Reference

New American Heritage Dictionary: Can it Compete?

BY RUBIN RABINOVITZ

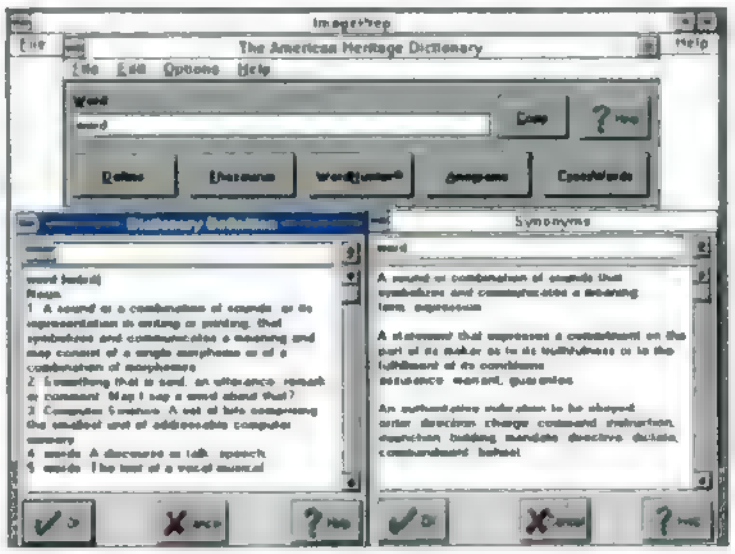
In its Windows version, the Second College Edition of WordStar International's American Heritage Electronic Dictionary is fast, attractive, and easy to use, especially in its efficient handling of cross-references.

It comes with a database of biographical and geographical entries, an anagram generator, a wildcard search for words with common letters (like terms ending in *-ism*), and a Boolean search for definitions that have words in common.

Also included is Roget's II Thesaurus, a so-so tool that hasn't been upgraded. The program can run from inside Ami Pro, Word for Windows, and WordPerfect for Windows.

Exactly how many words are included in the dictionary is unclear. WordStar claims it's the best, with 303,000 words (120,000 more than its closest competitor). WordStar identified the competitive product as Reference Software's Random House Webster's Electronic Dictionary and Thesaurus, College Edition, a 180,000-entry dictionary (First Looks, June 16, 1992).

After tests in which Random House Webster's consistently racked up higher scores than American Heritage, it became clear that something was up. Random House says that by its count—based on an industry standard formulated by the General Services Administration (GSA)— American Heritage has only 160,000 entries. Houghton Mifflin, developer of American Heritage, acknowledges that the 303,000-entry figure is based on a different counting method and allows that 160,000 is a reasonable figure using the GSA method.



SYNONYMS: *The American Heritage Dictionary displays definitions and synonyms.*

WordStar now agrees that its claim of 120,000 more words than RH Webster's was not an appropriate comparison.

Random House Webster's is, by a 20,000 entry-word margin, the most powerful floppy disk-based electronic dictionary. It costs less than American Heritage ($99 versus $129), and, because of superior file compression, uses less hard disk space (8MB versus 11MB). American Heritage is a good dictionary, but Random House Webster's is the best.

• List price: *American Heritage Dictionary, Second College Edition, $129.* Requires: *Microsoft Windows version: 2MB RAM, 11MB hard disk space, Windows 3.0 or later; DOS version: 640K RAM, 11MB hard disk space, DOS 2.1 or later. WordStar International Inc., 201 Alameda Del Prado, Novato, CA 94949; 800-523-3520, 415-382-8000; fax, 415-883-1629.*

Circle 416 on reader service card

Data Access

Q+E Bolsters Query Tools in Version 5.0

BY RON ANDERSON

With Q+E Database Editor, Version 5.0, from Pioneer Software, it's easier than ever to access the corporate data you need. The $299 Microsoft Windows–based front-end query tool (a subset of which is included in Microsoft Excel) has been significantly enhanced.

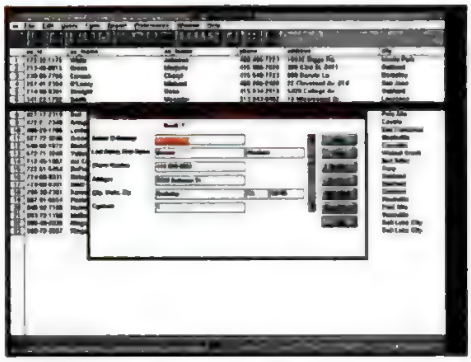
One of the primary strengths of Q+E has always been the sheer number of database formats it supports. This upgrade won't disappoint; it adds support for AS400, SQL, and Tandem NonStop SQL/DS, in addition to continuing to support DB2 via ASCII text files, Btrieve, dBASE, Excel spreadsheet files, Micro Decisionware's Gateway, INGRES, NetWare SQL, Oracle, Paradox, OS/2 DBM, SQLBase, SQL Server, Sybase, and XDB.

Major functional and user-interface improvements include an icon bar, a graphical data entry/edit form designer, an interactive query builder, fill-in-the-blank queries, and a business report builder. The interactive query builder alone is worth the price; the rest is gravy.

Anyone who's wrestled with the SQL language will be amazed at the ease with which complex queries are built on-the-fly by Q+E. The process begins by opening a file or table. You can open additional tables and execute relational joins, perform multiple sorts, enter selection criteria, compute totals and other aggregate functions, and define "group by" clauses by simple point-and-click and fill-in-the-blank procedures that are never obscure.

You don't need to be a SQL language expert to get to the information you need when using Q+E. The point-and-click interface does an excellent job of insulating you from the intricacies of SQL. If you want a more hands-on approach, the SQL queries built by Q+E can be viewed, edited, and executed directly. Novice SQL users can learn a great deal about SQL by viewing the queries they create during interactive sessions.

Customized data entry and edit forms are simple to create and modify. Once again, Q+E does most of the work for you. Data entry fields and labels are automatically created for each field in a table or view by the form designer. You can click and drag the fields to the position you desire and modify the field labels to suit your needs. Buttons to add, duplicate, and delete records; to restore records to their previous state; and to execute a query-by-example are automatically included on a new form.



FORM DESIGNER: *Customize quickly in Q&E.*

Q+E 5.0 is a major new release that empowers you by giving you better-than-ever access to your organization's information.

• List price: *Q+E, Version 5.0, $299.* Requires: *4MB RAM, Microsoft Windows 3.0 or later. Pioneer Software Inc., 5540 Centerview Dr., #324, Raleigh, NC 27606; 800-876-3101, 919-859-2220; fax, 919-859-9334.*

Circle 422 on reader service card

Printers

Pacific Data ProTracer: Good Choice for Quick CAD And DTP Drafts

BY MITT JONES

Pacific Data Products (PDP), long a leading developer of printer enhancements, is trying its hand at the whole package. The company bills its first printer—the $1,499 ProTracer—as a personal CAD printer.

This 360-dot-per-inch ink jet printer should earn an enthusiastic audience among CAD and DTP professionals with its speedy graphics performance, large media capability, and relatively low price.

Based on a Canon engine, the ProTracer shares its form factor and versatile paper-handling with the Canon Bubble Jet BJ-300 and IBM Exec-Jet Printer. The ProTracer features a built-in tractor feed and support for two optional, 100-page, single-sheet bins ($149 and $129). Like the Canon and IBM offerings, it handles paper as large as 17 by 23 inches through a front-panel manual feed.

The 64-nozzle ProTracer also shares its 300-dpi draft speed rating with these two past *PC Magazine* Editors' Choice recipients ("Ink Jets: Getting Faster, Getting Better," November 26, 1991). Unfortunately, PDP's offering comes nowhere close to matching the near-200-characters-per-second tested draft speed of these other Canon-based products. In text speed trials printing from a 20-MHz 386-based system, the ProTracer managed top speeds of only 46 cps in draft mode and 39 cps in letter-quality mode.

FAST CAD: *The ProTracer personal CAD printer does big drafts quickly.*

The advantages of the ProTracer over its competition begin with its Intel i960 RISC processor, which speeds graphics printing considerably.

Unlike the Canon and IBM offerings, the ProTracer specifically addresses the CAD and DTP markets. Though providing only Epson LQ-1050 and IBM Proprinter XL24E emulations in its base configuration, the printer comes with AutoCAD and Protected AutoCAD device drivers and accepts HPGL and PostScript emulations via two card slots. HPGL emulation is $399 for the card plus $599 for the 5MB memory upgrade. PostScript emulation is $499 plus $599 for 5MB of memory or $899 for 8MB.

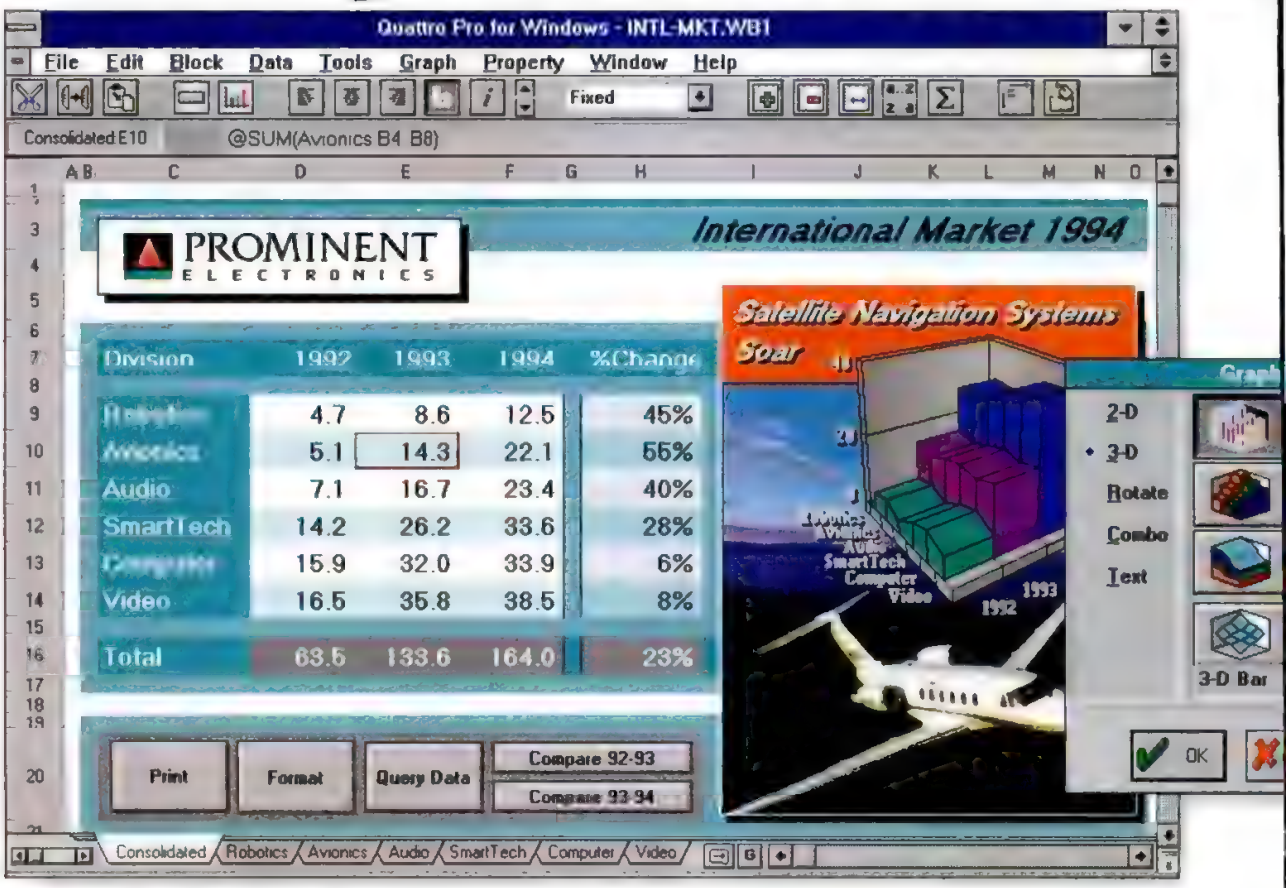
The printer uses a $24 Canon BJI-6425 ink cartridge good for about 500 pages—about 5 cents per page.

If you need high-quality, large-media, plotter and/or PostScript output—the ProTracer is a great value.

• List price: *ProTracer, $1,499. Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121, 619-552-0889; fax, 619-552-0889.*

Circle 419 on reader service card

Excel and 1-2-
Quattro Pro



Quattro Pro for Windows *is the easiest-to-use spreadsheet ever made. Built with Borland's renowned object-oriented technology, Quattro® Pro for Windows is packed with hot new features you won't find in any other spreadsheet.*

NEW! Spreadsheet Notebooks with customizable Tabs are nothing less than a revolution in spreadsheet ease of use. Now you can intuitively organize and manage your spreadsheet data.

NEW! Object Inspector™ menus end the hassle of searching through menus. They're simpler than 1-2-3. Just click the right mouse button anywhere on the screen to get a list of what you can change and change it right there.

NEW! Database Desktop™ is the easiest way to incorporate dBASE® and Paradox® data into your spreadsheet. Just what you'd expect from Borland, the leader in database technology.

NEW! SpeedFill™ and **SpeedFormat™** slash setup time by automatically filling in spreadsheet headings and formats.

NEW! SpeedBars™ are customizable and context-sensitive. SpeedBar icons give pushbutton access to your most frequently used commands.

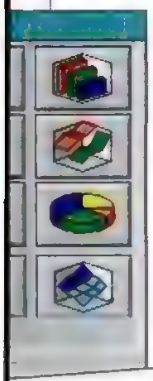
NEW! Presentation Graphics and drawing tools that rival those of Freelance and Harvard Graphics are built-in. You don't need to buy a separate graphics package.

YES! Compatible with Lotus 1-2-3 files, macros, and publishing styles; Excel .XLS files; and eight graphic formats. Quattro Pro for Windows offers the best spreadsheet, database, and graphics file compatibility available.

-3 users prefer for Windows

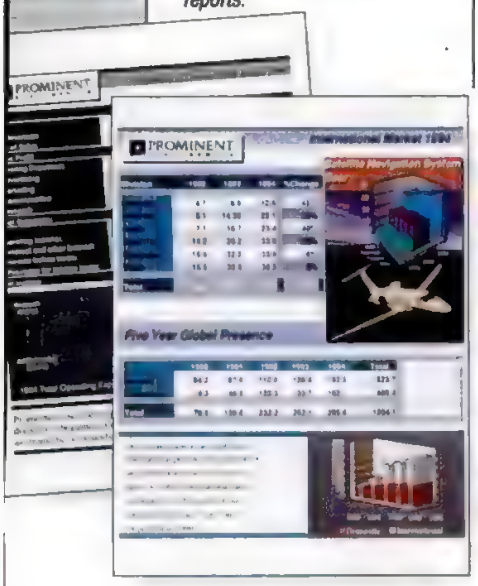
An independent test proves...

It's a fact: two out of three Excel and 1-2-3 spreadsheet users tested prefer Quattro Pro for Windows to their current spreadsheet. They say it makes you more productive and is easier to learn and use. That's the result of a study conducted by Usability Sciences Corporation, a highly regarded independent testing lab used by major software publishers, including Lotus.



◀ *The Object Inspector makes it easy to view and select your options.*

▼ *WYSIWYG printing makes it easy to create high-impact reports.*



...the easiest-to-use spreadsheet...

Quattro Pro for Windows is the most advanced, yet easiest-to-use spreadsheet ever created for the personal computer. Thanks to the use of new object-oriented technology, Borland has radically simplified the use of the world's most feature-rich spreadsheet. With Quattro Pro for Windows you get your work done faster because you work visually. Simple point-and-click operations are all that's needed to complete any spreadsheet task—from building your spreadsheet to creating dazzling graphical reports.

...makes you more productive

Never before has so much spreadsheet power also meant this much user productivity. Spreadsheet Notebooks and Object Inspector menus are breakthrough concepts that make it easy to tap the awesome functionality of Quattro Pro.

Only Quattro Pro for Windows gives you transparent access to database information. Borland's unique Database Desktop lets you view, edit, and copy dBASE and Paradox tables directly from within Quattro Pro. Plus, we've included all the tools you'll ever need for creating your own custom spreadsheet applications.

Quattro Pro for Windows
November 10, 1992

"Quattro Pro for Windows is a better spreadsheet than Excel 4.0."

—*Computer Shopper*, November 1992

1-2-3 and Excel users tested prefer Quattro Pro for Windows two to one. But why not see the world's best Windows spreadsheet for yourself? Get Borland's new Quattro Pro for Windows today.

Special limited-time offer!

Quattro Pro for Windows and DOS

Now together for the price of one.

See your dealer today or call now,

1-800-331-0877, ext. 5916

In Canada, call 1-800-461-3327

BORLAND

Software Craftsmanship

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CIRCLE 287 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Emerson Andrew Torgan

NEW

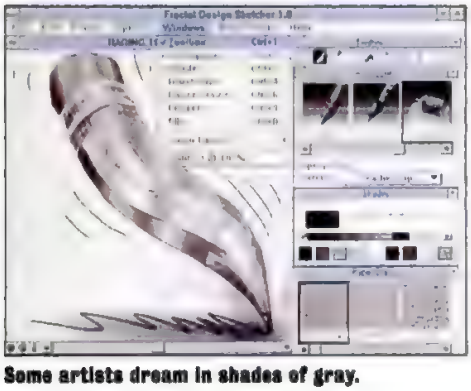
Fractal Design Sketcher: Not Everyone Dreams in Color

Fractal Design Corp., the maker of Fractal Design Painter, has unveiled a new gray-scale paint- and image-editing software program for the Microsoft Windows environment. Fractal Design Sketcher for Windows, Version 1.0, is designed for creative professionals such as graphic artists, cartoonists, and desktop publishers who work in a monochrome environment. Sketcher includes such tools as pencils, crayons, calligraphy pens, airbrushes, friskets, and paint brushes for oils and watercolors. Like Painter, it includes brushes that simulate the styles of Van Gogh and Seurat. It also has an Auto Van Gogh feature that automatically applies the effects to an entire image.

Sketcher offers a number of special effects, including Distort, Unsharp Mask, SuperBlur, Equalize, and Posterize. There is also a resize command and a browse command (which allows you to view thumbnail sketches of both Painter and Sketcher images). The desktop interface is customizable, with user-selectable tear-off brushes. You can record and play back brush strokes or entire sessions. A choice of 12 different paper textures is available from the paper-texture library. The program has the ability to generate text and objects via friskets, and can create text friskets from imported Adobe Type 1 and TrueType fonts. Outlines can be filled with brush strokes, paper textures, or photographs. Text can be rotated, distorted, and scaled.

• List price: *Fractal Design Sketcher for Windows, Version 1.0, $149. Fractal Design Corp., 335 Spreckels Dr., Aptos, CA 95003; 408-688-8800; fax, 408-688-8836.*

Circle 402 on reader service card



Some artists dream in shades of gray.

HOT PROSPECT

Microsoft Video for Windows

Microsoft Corp. has unveiled Video for Windows, Version 1.0, digital video software that lets you play full-motion color video sequences in the Microsoft Windows environment. The software-only solution provides a set of tools for creating, editing, compressing, and playing digital video. You can play standalone video sequences, or you can add them to documents or files in applications that support (OLE) Object Linking and Embedding. Sequences authored under Video for Windows can be played back on a wide variety of hardware platforms, with playback resolutions ranging from 160 by 120 pixels to 640 by 480 pixels with the addition of third-party video hardware. Playback speeds range from 15 frames per second to full-motion video at 30 frames per second.

The package consists of several components, including a video playback application, an MCI Driver to the Media Control Interface, a CD-ROM with more than 250 sample files, and Video Capture/Editing tools. It also includes compression tools, and supports a number of compression products available from third-party vendors.

• List price: *Video for Windows, Version 1.0, $199. Microsoft Corp., One Microsoft Way, Redmond, WA 98052. 800-429-9400, 206-882-8080*

Circle 401 on reader service card

NEW

An Optical Drive That May Truly Inspire You...

In the ongoing battle between optical storage companies to produce the fastest optical drive, **Alphatronix** is rolling a new high-speed optical storage solution up to the front lines. Promising an average seek time of 23 milliseconds, the Inspire II is going head-to-head with offerings from Quantum and Pinnacle Micro. The unit employs a new asymmetric split head that is very light, and full read and write caching to speed data transfer and throughput. It also has a DSP-based minimum trajectory seek method that minimizes the number of seeks required. An additional feature that enhances data reliability is the company's Alphaguard feature, a process in which every byte of data is checked twice as it is read from or written to the optical disk. Inspire II drives are available in configurations of 650MB and 1GB.

• List price: *Inspire II (650MB version), $4,495; (1GB version) $4,995. Alphatronix Inc., 4022 Stirrup Creek Dr., P.O. Box 13687, Research Triangle Park, NC 27709. 800-849-2611, 919-544-0001; fax, 919-544-4079.*

Circle 403 on reader service card

NEW

Find Answers to Your Networking Questions on CD-ROM

Ziff Desktop Information's Computer Library has unveiled Support On Site for Networks, a CD-ROM database of multivendor technical support information on more than 100 networking hardware, software, and connectivity products. The CD-ROM (available on an annual subscription basis with monthly updates) contains up-to-date information on popular network operating systems, network interface cards, servers, hard disks, networked application software, hubs, bridges, and routers. A compilation of manuals, installation guides, board-level diagrams, ancillary software such as patches and drivers, and technical notes, Support on Site for Networks contains more than 25,000 documents supplied by vendors such as 3Com, Banyan, IBM, Lotus, Microsoft, and Novell.

The search-and-retrieve environment lets you search the database using any word or com-

Photography by Thom O'Connor

bination of words. Boolean operators (AND, OR, NOT, WITHIN) and approximate designators for "Sentence" and "Paragraph" let you narrow your search. A fielded search facility lets you focus your search by supplying a template.

• List price: *Support On Site for Networks, single user, $1,495; up to five users, $4,995. Computer Library, One Park Ave, New York, NY 10016. 800-827-7889 ext. 517, 212-503-4400; fax, 212-503-4414.*
Circle 404 on reader service card

NEW

Oh Give Me a Home Where The Network Can Roam

Shiva Corp. has unveiled LanRover/4E for NetWare (four-port version) and LanRover/8E for NetWare (eight-port version), a pair of multiport dial-in access servers that provide transparent remote networking for PC users. Used in desktop or rack-mounted configurations, LanRover/E servers include client software that lets remote DOS and Microsoft Windows users access network services such as e-mail, client/server databases, and groupware. The client comes with an unlimited site license, and DOS and Windows versions of Shiva Net Manager, which provides central configuration, management, and monitoring of multiple LanRover/E units over a network—even remotely. Security features include automatic callback and individual and administrator passwords.

• List price: *LanRover/4E, $1,999; LanRover/8E, $2,999. Shiva Corp., One Cambridge Center, Cambridge, MA 02142; 800-458-3550, 617-252-6300; fax, 617-252-4852.*
Circle 407 on reader service card

IMPROVED

HALO Desktop Imager Gains New Photo Retouching Tools

Media Cybernetics is shipping an update to its Microsoft Windows imaging utility. HALO Desktop Imager, Version 2.0, provides a palette of image-retouching tools, a new visual file-management interface called "Gallery," full support for Kodak Photo CD images, and support for the Twain standard. It also has color separation capability and improved integration with Windows applications, including support for OLE (Object Linking and Embedding) and drag-and-drop.

HALO's new photo-retouching tools include a special-effects brush for lightening, darkening, softening, sharpening, blurring, and blending, as well as a scramble function for seamless image blending, according to the company. Pencil, brush, special effects, intelligent erase and ditto operations function at any zoom level, providing editing down to a single pixel. Ditto replication works across multiple images. The erase brush offers a "partial undo" feature, letting you manage images in layers.

• List price: *HALO Desktop Imager, Version 2.0, $169. Media Cynernetics Inc., 8484 Georgia Ave., Silver Spring, MD 20910; 310-495-3305; fax, 301-495-5964.*
Circle 405 on reader service card

BRIEFS

PORTABLES, PALMTOPS, AND PERIPHERALS

Aspen Computers is shipping its new Aquiline NT450 ($3,595), a 486/50DX2-based notebook PC with a 240MB hard disk and 4MB RAM. The 7.9-pound unit has an 8.75-inch VGA LCD with 32 shades of gray, a 3.5-inch floppy disk drive, an external VGA port, an external keyboard port, 2 serial ports, 1 parallel port, an external numeric keypad, and 1 expansion port for a docking station ($295). It is also available configured with 4MB RAM and a 170MB hard disk ($3,395), and with 4MB RAM and a 120MB hard disk ($3,195). 800-370-3322.

AST Research has introduced the PowerStation docking station ($499) and the EasyPort port replicator ($99) for AST's PowerExec notebook. 800-876-4278, 714-727-4141; fax, 714-727-9355.

Axonix Corp. has introduced the CableMate ($149), a laptop and notebook cable management device. CableMate acts as a docking bar, and is available for Compaq, Toshiba, and Dauphin notebooks, with facilities for additional models to be added in the near future. 800-866-9797, 801-466-9797; fax, 801-485-6204.

Canon Computer Systems has unveiled the Innova 386NX ($1,999) and the Innova 486NX ($3,999). The Innova 386NX is a monochrome notebook PC powered by the AMD 386SX chip running at 25 MHz. The 5.3-pound unit has a 10-inch screen, and ships in standard configuration with 4MB RAM, one 3.5-inch floppy disk drive, a 60MB hard disk, and an internal 9,600-bps data/fax modem. The Innova 486NX is powered by the Intel 486SX chip running at 25MHz. The 5.8-pound unit has a 9.2-inch passive-matrix color display, and ships in standard configuration with 4MB RAM, one 3.5-inch floppy disk drive, and a 120MB hard disk. 800-848-4123.

Intellicom has unveiled the TP-PNAII ($509) and TP-PNAII/QL ($585) portable network adapters for portable computers. The TP-PNAII incorporates both an RJ-45 and a Thin Ethernet

NEW

Compaq Ships Passive-Matrix Color Contura Notebook

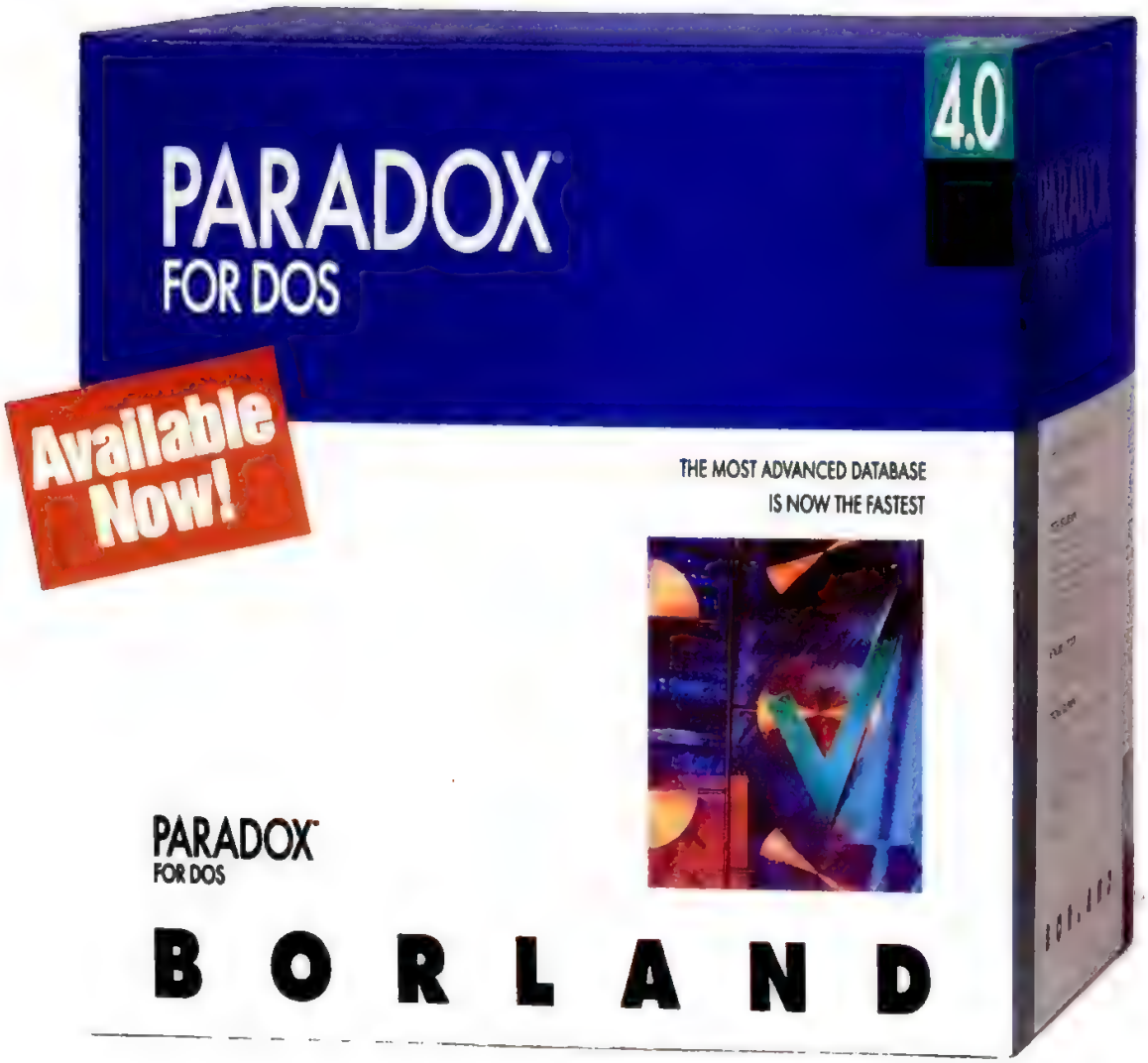
Compaq's new Contura 3/25c, the latest member of the company's line of low-priced systems, is a 6.7-pound, 386SL-based notebook PC running at 25 MHz. It has a 9-inch passive-matrix color VGA display, and features a Compaq-designed graphics chip and software drivers optimized for Windows 3.1.

The Contura 3/25c is available in two models. The Model 84/w ships in standard configuration with 4MB RAM (expandable to 12MB RAM); one 3.5-inch, 1.44MB floppy disk drive; and an 84MB hard disk with a 64KB cache. The Model 120/w ships in standard configuration with 4MB RAM (expandable to 12MB RAM); one 3.5-inch, 1.44MB floppy disk drive; and a 120MB hard disk with a 64KB cache. Both units ship with a nickel hydride battery pack that promises up to 3 hours of battery life and a fast 1-hour recharge time. The units come with an external Compaq trackball and have both DOS 5.0 and Microsoft Windows 3.1 preinstalled.

• List price: *Contura 3/25c (Model 84/w), $2,799; Contura 3/25c (Model 120/w), $3,099. Compaq Computer Corp., P.O. Box 69-2000, Houston, TX 77269; 800-345-1518, 713-370-0670.*
Circle 406 on reader service card

The Compaq Contura 3/25c Model 84/w.

Not so fast Microsoft—
the world's *fastest* PC database comes from Borland!



An offer that will get you up to *speed* now!

Ranked #1 in performance!

Upgrade to Paradox 4.0 now!

Independent tests (*InfoWorld*, September 1992) prove that new Paradox® 4.0 is the fastest, most powerful database among those tested. And it's available now! (*Compare that with Microsoft's offer. They want you to pay $200 now for a slower product with the promise of getting an unannounced upgrade as soon as it comes off the vaporware list.*)

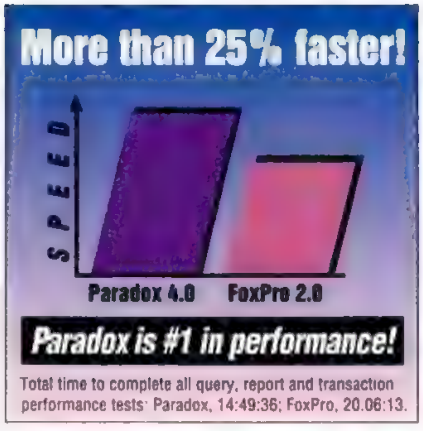
Paradox is fastest

Thanks to Borland's new WarpSpeed™ performance, Paradox 4.0 sets the standard in performance for both network and stand-alone use. For you, this means faster answers to queries, faster memory access, and faster multiuser applications. (*Don't be misled by Microsoft ads that claim FoxPro is the fastest. It's old news.*) As *InfoWorld* put it in the speed tests for Querying/Reporting: "Paradox is the hands-down winner, not only in speed, but in maintaining an amazingly consistent performance as the tests became more complex."

Unmatched power and ease of use

In addition to unmatched performance, Paradox 4.0 sports a new windows-like interface with pull-down menus, dialog boxes, windows, and mouse support. This new interface makes Paradox the most usable database for everyone in your corporation.

Paradox is renowned for its ease of use. Paradox introduced Query By Example, the easiest way ever for users to get at their data. And Paradox forms and reports are a snap to create. You can even build multi-table forms and reports, all without programming.



"Tuned-up Paradox 4.0 speeds past FoxPro 2.0."
InfoWorld *product comparison, September 28, 1992.*

With Paradox 4.0, you can also manage more types of data in more ways than ever before. Paradox 4.0 includes memo fields for storing unlimited amounts of text. And new binary fields let you store any type of information—documents, spreadsheets, pictures, sound, and even multimedia.

Application development is faster, too

When it comes to application development, Paradox is ready. The Paradox Application Language (PAL™) is a powerful, high-level procedural language that allows you to create sophisticated applications quickly. And the new Application Workshop helps developers build and distribute robust applications in record time. Now you can create custom applications that users love.

Protecting your investment

Paradox 4.0 provides a smooth migration from earlier versions. It runs all your existing Paradox 3.5 applications and can access your data transparently. What's more, Paradox talks to more of your corporate data than any other PC database, with transparent links to Oracle, Sybase/Microsoft,® DEC VAX Rdb, IBM® OS/2® DBM, DB2, Novell NetWare, and InterBase™ server.† (*By comparison, FoxPro talks only to itself.*)

You can buy Paradox 4.0 *today* with total confidence because it comes from Borland—the leader in databases. Our commitment starts with best-of-breed products and follows through with the best solutions, best support, and best service in the business.

InfoWorld says it all: "Just as Borland predicted, Paradox 4.0 is faster than FoxPro 2.0."

Put the world's fastest database to work for you.

To upgrade or order, see your dealer today or call 1-800-331-0877, ext. 6060

In Canada, call 1-800-461-3327

30-DAY MONEY-BACK GUARANTEE

Software Digest — PARADOX 4.0 ★★★ Rated #1 — Vol. 9, Number 2 May 1992
Paradox 4.0 May 1992

Paradox 4.0 August 1992

COMPUTERWORLD — BEST TECHNOLOGY, BEST SERVICE/SUPPORT, BEST DOCUMENTATION, BEST PRICE/PERFORMANCE
Paradox 3.5 June 1992

1992 BYTE READERS CHOICE AWARD
Paradox 3.5 June 1992

PC WORLD — WORLD CLASS AWARD
Paradox 3.5 October 1991

PC MAGAZINE — EDITORS' CHOICE
Paradox 3.5 May 1991

B O R L A N D

Software Craftsmanship

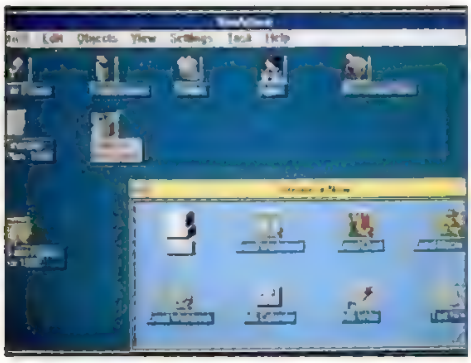
†Paradox SQL Link sold separately. InterBase connection available soon. Copyright © 1992 Borland International, Inc. All rights reserved. Paradox, WarpSpeed, InterBase, and PAL are trademarks of Borland International, Inc. *PC Magazine* Editor's Choice Award reprinted from *PC Magazine*, May 28, 1991, Copyright © 1989, Ziff Communications Company. *Software Digest* is a registered trademark of NSTL, Inc. BI 4907

CIRCLE 220 ON READER SERVICE CARD

NEW

HP NewWave 4.1 Arrives with a Promise of Faster Performance

Hewlett-Packard's upgrade to its NewWave desktop manager for Microsoft Windows offers better integration with DOS and Windows applications, a quicker installation routine, and faster performance than its predecessor, HP NewWave 4.0. According to the company, opening objects on the desktop in HP NewWave 4.1 is up to 40 percent faster than it was in HP NewWave 4.0; opening folders is 60 percent faster. Most common operations, such as emptying the wastebasket, are about twice as fast as Version 4.0.



NewWave 4.1 lets you create objects quickly.

A new "Quick Install" feature automatically installs DOS and Windows applications onto the NewWave desktop. A "Create New Object" tool can be left open, acting as a template. You can "tear off" the desired application type and create a new object directly on the desktop. HP NewWave also has an enhanced filename display, and a new printer tool.

• List price: *HP NewWave, Version 4.1, $195; upgrade from previous version, $49. Hewlett-Packard Co., 974 E. Arques Ave., Sunnyvale, CA 94086; 800-554-1305, 408-720-3441; fax, 408-720-4033.*

Circle 410 on reader service card

NEW

Pacific Data Rolls Out HP LaserJet 4 Add-ons

Pacific Data Products has unveiled Pacific Connect Xi, Pacific 4 SIMM Printer Memory, and two font cartridges for the Hewlett-Packard LaserJet 4 printer. Pacific Xi, available in eight different models, is a multiplexer board that allows any combination of up to ten PCs and Macintoshes to be simultaneously connected to one HP LaserJet printer. The board uses the MIO (modular I/O) port, standard on the LaserJet 4 and IIISi, or the optional I/O (XIO) port on the LaserJet II, IID, III, and IIID printers. Pacific 4 SIMM Printer Memory is available in 1MB, 2MB, 4MB, and 8MB configurations and can be used in various combinations to expand the LaserJet 4's standard memory to a maximum of 32MB.

The font cartridges Pacific Data Products is shipping are the Complete Font Library and 25 in One! III. The Complete Font Library provides 51 scalable PCL 5 typefaces; 25 in One! III, a bitmapped font cartridge, provides 172 fonts and complete international symbol sets in point sizes from 3.6 to 18 points.

• List price: *Pacific Connect Xi (10 port version with 4MB RAM), $999; Pacific Connect Xi (7 port version with 1MB RAM) $599; Pacific 4 SIMM Printer Memory, 1MB, $79; 2MB, $139; 4MB, $299; 8MB, $429; The Complete Font Library, $399; 25 in One! III, $399. Pacific Data Products, 9125 Recho Rd., San Diego, CA 92121; 619-552-0880; fax, 619-552-0889.*

Circle 408 on reader service card

BRIEFS

PORTABLES, PALMTOPS, AND PERIPHERALS

connector. The TP-PNAII/QL features Intellicom's Quick-Link for Windows, and lets users establish single and multiple application sessions with a file server running a supported Network Operating System such as Novell's NetWare or Banyan's VINES. Both units attach to a PC via the parallel port with a flexible ribbon cable. 818-407-3900; fax, 818-882-2404.

Laptop Solutions has announced hard disk upgrades of 1GB ($3,495) for the Toshiba T6400, T5200, and T5100 systems. 800-683-6839; fax, 713-789-8177.

Liberty Systems is now shipping the 30 Series of portable hard disk drives, small enough to fit in a shirt pocket, and equipped for both the PC and Macintosh. Available in 80MB ($899) and 120MB ($1,099) configurations, the 30 Series has both a SCSI connection and a parallel port. It accepts removable cartridges and has a pass-through connection for printers via the parallel port. 408-983-1127; fax, 408-243-2885.

New Media Corp. has announced the credit card-size PalmModem ($259) for subnotebook and palmtop computers, developed on the PCMCIA 1.0 standard. The unit ships with software designed for the HP95LX and includes Xmodem, Ymodem, and Kermit modem file-transfer protocols. 714-453-0100; fax, 714-453-0114.

PC Guardian is shipping the Notebook Guardian for the Toshiba T4400SX ($69.95), a 5-foot steel cable that secures the notebook to a stationary object. 800-288-8126, 415-459-0190; fax, 415-459-1162.

Unlimited Systems Corp. is shipping the Konexx Kit ($169), designed to provide modem communications over public phones or anywhere that access to a phone jack is impossible. The Konexx Kit includes the Konexx Koupler Model 203 (an acoustic coupler), the Merlin Phone Adapter, a 7-foot modem cable, a 9-volt battery, and a carrying case. 800-275-6354.

IMPROVED

PC-Kwik Updates Super PC-Kwik And PC-Kwik Power Pak

PC-Kwik Corp. has announced an update to its DOS-based disk speed-up product. PC-Kwik Power Pak, Version 3.0, includes an enhanced version of its disk-caching program, Super PC-Kwik, Version 5.0. Power Pak 3.0 also includes an update of Power Disk, a disk reorganizer, and the KwikBoot module, which provides up to 26 DOS boot configurations.

Super PC-Kwik 5.0 has a number of speed enhancements and an option to select delayed writes, a method of caching data being written to a disk drive that can improve disk performance. It also automatically detects applications using VCPI and DPMI memory.

Power Disk, previously available as a separate product, is now integrated into Power Pak 3.0, and has a new graphical interface. It lets you schedule regular disk defragmenting, file sorting, and disk testing on boot-up. Additional new features in Power Pak 3.0 include keyboard aliases, an enhanced type-ahead buffer, and the ability to save the ReView screen buffer to a file. Keyboard aliases let you create short commands to replace long or multiple DOS commands. The expanded keyboard buffer lets you type ahead without waiting for the DOS prompt to return from a previous function.

• List price: *PC Kwik PowerPak, Version 3.0, $129.95; Super PC-Kwik, Version 5.0, $79.95. PC-Kwik Corp., 15100 SW Koll Pkwy., Beaverton, OR 97006; 800-759-5945, 503-644-5644; fax, 503-646-8267.*

Circle 409 on reader service card

NEW

Canon Puts Its Own Brand on Two Laser Printers

If you know something about laser printers, then you know that the majority of them have a Canon engine. Two new entries into the laser printer arena also feature the Canon engine—and the Canon name.

Canon Computer Systems has unveiled the LBP-4sx and the LBP-8sx, two 300-dot-per-inch resolution laser printers with text smoothing, scalable fonts, and PCL 5 compatibility. The LBP-4sx is a 4-page-per-minute desktop unit designed for individual use. The larger and faster (8-ppm) LBP-8sx is designed for higher-volume use and to be shared in a multiuser environment. The units ship in standard configuration with 12 resident scalable fonts, 12 resident bitmap fonts, and 1MB RAM. The LBP-4sx has a standard 70-sheet multipurpose paper tray (letter, legal, A4, and envelopes), and an optional 250-sheet lower tray is available. The LBP-8sx comes with a 200-sheet letter cassette, and an optional 200-sheet legal or A4 cassette is available. In addition to PCL 5 compatibility, the new printers also offer popular dot-matrix emulation and automatic emulation switching between all resident printer modes.

• List price: *LBP-4sx, $1,595; LBP-8sx, $2,395. Canon Computer Systems Inc., 123 E. Paularino Ave., P.O. Box 5048, Costa Mesa, CA 92628; 800-848-4123.*

Circle 411 on reader service card

NEW

Pillar Offers Windows Version of FYPlan Budgeting System

Pillar Corp. has introduced FYPlan for Windows, Version 1.0, an enterprise-wide budgeting system the company first introduced on the Macintosh platform. FYPlan lets you develop annual budgets and rolling forecasts, including revenues, expenses, and capital expenditures. It also offers business modeling, automatic consolidations, and integrated P&L, balance sheets, and cash flow statements.

FYPlan consists of three components: a Mothership component for system administrators to set up user security levels; a Consolidate component that permits the consolidation of budget data; and Satellite components—front-end applications distributed to line managers that contribute to the consolidated budget. The program is centered around the company's Open Framework technology, meaning that FYPlan has a common code across different platforms. A built-in database lets you generate customized reports and graphs by searching through and sorting planning data. Data from existing systems, including corporate general ledgers, spreadsheets, and personnel files can be imported into the program.

• List price: *FYPlan for Windows, Version 1.0, five-user system (Mothership component and four Satellites) $19,500. Additional users (Satellite components) from $500 (depending on configuration). Pillar Corp., 950 Tower Ln., #400, Foster City, CA 94404; 415-349-6200; fax, 415-349-5515.*

Circle 413 on reader service card

BRIEFS

MONITORS

Amdek, a Wyse Technology company, has introduced its first line of non-interlaced monitors specifically designed for Microsoft Windows–based applications. The high end includes three new SuperVGA color displays offering resolutions of up to 1,024 by 768. The low end includes two color monitors, and one monochrome monitor. The AM/815 ($799) is a 15-inch flat-square color monitor with a 28mm dot pitch and a maximum resolution of 1,024 by 768 at a refresh rate of 72Hz. It has a built-in "pin cushion" adjustment for color calibration. The AM/814 ($699) is a 14-inch color monitor with a .28mm dot pitch and a maximum resolution of 1,024 by 768 at a refresh rate of 70Hz. The AM/814LC ($649) is a low-price version of the AM/814, providing a refresh rate of 60Hz. The AM/732E ($599) is a 14-inch color monitor with a .28mm dot pitch; the monitor supports a maximum resolution of up to 800 by 600. The AM/732C ($499) is a color monitor, and the AM/432N ($199) is a 14-inch VGA monochrome monitor. 800-722-6335; fax, 800 742-6335

Nanao USA Corp. has announced the low-cost 15-inch FlexScan F340iW ($899) designed for Windows-based applications. The unit has a .28mm dot pitch and supports a maximum resolution of up to 1,024 by 768 at a refresh rate of 76Hz. The front panel of the F340iW has Nanao's Microprocessor Advanced Image Control System which provides 28 different settings for screen configurations and display modes. Nanao is also shipping the 21-inch FlexScan F7501 ($3,299), a flat-square color display with a .31mm dot pitch and a maximum non-interlaced resolution of 1,280 by 1,024 at a refresh rate of 74 Hz. It also offers a resolution of 1,024 by 768 at a refresh rate of 90Hz. 310-325-5202; fax, 310-530-1679.

Optiquest is shipping the 4000DX ($1,195), a 17-inch flat-square color monitor with a .31mm dot pitch and a maximum non-interlaced resolution of 1,024 by 768 at a refresh rate of 72Hz. 800-843-6784, 310-948-1185.

NEW

Boldly Go Where No Screen Saver Has Gone Before...

Captain's Log, StarDate 2392: Ship's sensors are picking up strange activities on the planet's surface. It seems that the once-lifeless technology centers are undergoing a transformation—an accelerated rebirth—as we enter into orbit. Mr. Spock, Dr. McCoy, Mr. Scott, and I will beam down to the planet's surface.

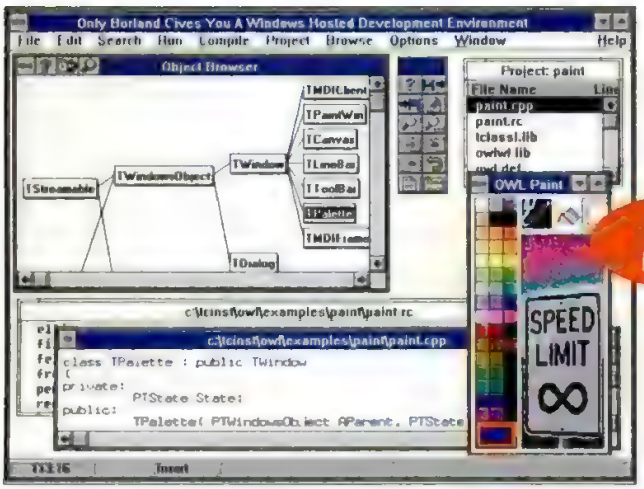
Berkeley Systems, makers of the popular screen saver After Dark, now bring you Star Trek: The Screen Saver. Don't look for Captain Picard in this package. This is not the Next Generation, but the First Generation of Star Trek characters, including Kirk, Spock, McCoy, and Scotty (you'll even hear Bones utter the famous, "He's dead, Jim."). It features the theme music from the original television series. Star Trek: The Screen Saver delivers everything you would expect: Klingon battle cruisers, Tribbles, McCoy's vital signs monitoring screen in sick bay, and of course, the bridge view of the planet's surface. Set your phaser on stun, and keep a sharp lookout for the flying brain cells! Open a hailing frequency...

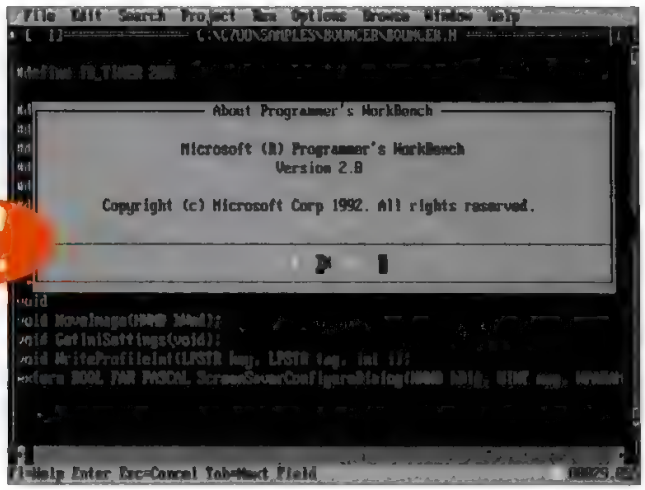
• List price: *Star Trek: The Screen Saver, $59.95. Berkeley Systems, 2095 Rose St., Berkeley, CA, 94709. 800-877-5535, 510-540-5535; fax, 510-540-5115.*

Circle 414 on reader service card

Engineering! I've got to have more power!

Borland C++ does





VS.

Borland C++ & Application Frameworks

Streamline your development cycle by creating Windows applications within the graphical Windows environment.

Microsoft C/C++

Why write a Windows application using character-mode DOS? *It doesn't make sense.*

Real programmers speak out on Borland C++ vs. Microsoft C/C++

"My level of productivity with Borland's products is way beyond what I get out of Microsoft's products." —Larry Skinner, Kingsport, TN

"After using both Microsoft and Borland products throughout the years, I am convinced that Borland has . . . the best value for the customer." —Mark Coopenstein, Kingsport, TN

"Our Windows development team is trying to gear up for our move from C to C++. Borland's third-generation C++ compiler gives us a lot more confidence to make the move to C++ than the first-generation C++ attempt from Microsoft." —John Ferguson, Springdale, AR

"Borland was the first out of the starting gate with C++, the first to offer Windows programming in one package, and the first to let me debug without quitting what I'm doing." —Tom Blough, Fort Worth, TX

"When I installed the program [Microsoft® C/C++], it corrupted my Windows program manager and it took me five hours to get it working again. I then realized I had made a mistake. I just cannot believe that the people who invented Windows would have a development program that does not run in Windows." —Barry Bowen, Memphis, TN

"We bought it [Microsoft C/C++] because of the low price but we gave up on it after two weeks of frustration." —Jeffrey Kho, Fremont, CA

"There's no support for OS/2® [in Microsoft C/C++] even planned, and the default install on my system failed to compile the example programs!" —Steven C. Stambach, Fresno, CA

"The Microsoft Foundation Classes (MFC) is difficult to use if you are new to Windows. The compile times are slower than C 6.0. And the most aggravating thing was that MS charged me extra for the SDK documentation." —Larry Skinner, Kingsport, TN

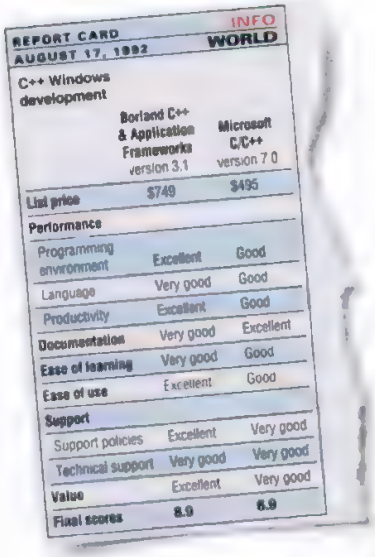
"I believe Borland C++ is a better development tool because the entire development environment is Windows-based." —Mark Oswald, Boca Raton, FL

"Borland's consistent quality makes it easy to use and recommend their products. This level of quality is a target we strive for in the products we produce. Our tool has become our goal!" —Scott Wallace, Oklahoma City, OK

"Borland® C++ is a superior development tool. The integrated development environment is programmer intuitive and developer friendly. . . . Borland just plain offers developers more options and better quality." —Thomas Jonas, Minneapolis, MN

"Let's be honest. Microsoft is good. But Borland is the best." —Michael Passalacqua, San Diego, CA

Windows better!



REPORT CARD — INFO WORLD
AUGUST 17, 1992

C++ Windows development

	Borland C++ & Application Frameworks version 3.1	Microsoft C/C++ version 7.0
List price	$749	$495
Performance		
Programming environment	Excellent	Good
Language	Very good	Good
Productivity	Excellent	Good
Documentation	Very good	Excellent
Ease of learning	Very good	Good
Ease of use	Excellent	Good
Support		
Support policies	Excellent	Very good
Technical support	Very good	Very good
Value	Excellent	Very good
Final scores	8.9	6.9

These programmers have learned that the best tools for Windows don't come from the company that makes the operating system. They come from the company that makes the best Windows and DOS compilers—Borland.

With Borland® C++ you get a complete Integrated Development Environment (IDE) for Windows and DOS. Your development cycle is streamlined because you can create, edit, and run your Windows applications all from within a graphical Windows environment.

You'll love the convenience and power of the IDE, with its special features like the ObjectBrowser™ to show you class relationships and help you navigate through your code, and the special SpeedBar™ for instant access to commonly used functions.

Integrated Resource Workshop VS. disintegrated SDK

With Borland's Resource Workshop you can create Windows resources quickly and easily. You just "draw" great-looking Windows resources like dialog boxes, buttons, icons, and more. It's infinitely simpler than wrestling with the SDK.

Write less code VS. write more code

Borland's Application Frameworks™ let you "bolt on" a complete user interface with just a few lines of code. Our ObjectWindows™ high-level objects give you graphical user interfaces with far less code than the low-level Microsoft Foundation Classes. And Turbo Vision™ gives you great ready-to-plug-in user interfaces in character mode for DOS.

Powerful tools VS. limited tools

Borland C++ gives you a complete selection of the finest tools. Turbo Debugger® for Windows and DOS debugs code fast. Turbo Profiler™ pinpoints bottlenecks in your code. WinSight™ helps monitor Windows activity. And you also get object-oriented Turbo Assembler® and more than 4,500 pages of clear, comprehensive documentation.

Full C++ VS. partial implementation

Full language compliance is key in a compiler and only Borland complies with AT&T's CFRONT 3.0 C++ standard. Only Borland gives you templates so you can create reusable code for the container classes and other parameterized types.

Third-generation VS. first attempt

Borland's third-generation C/C++ compiler brings you the power and reliability that only comes with experience. Borland gives you a faster C/C++ compiler with great features like a smart project manager and automatic, safe precompiled headers. Just some of the many reasons why we've sold more than 700,000 C/C++ development systems to professionals worldwide.

Go with the best

The best C and C++ tools for Windows are from the leader in Object-Oriented Programming. Trust your code to Borland. See your dealer today, or

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1991 BYTE AWARD DISTINCTION — January 1992, Borland C++

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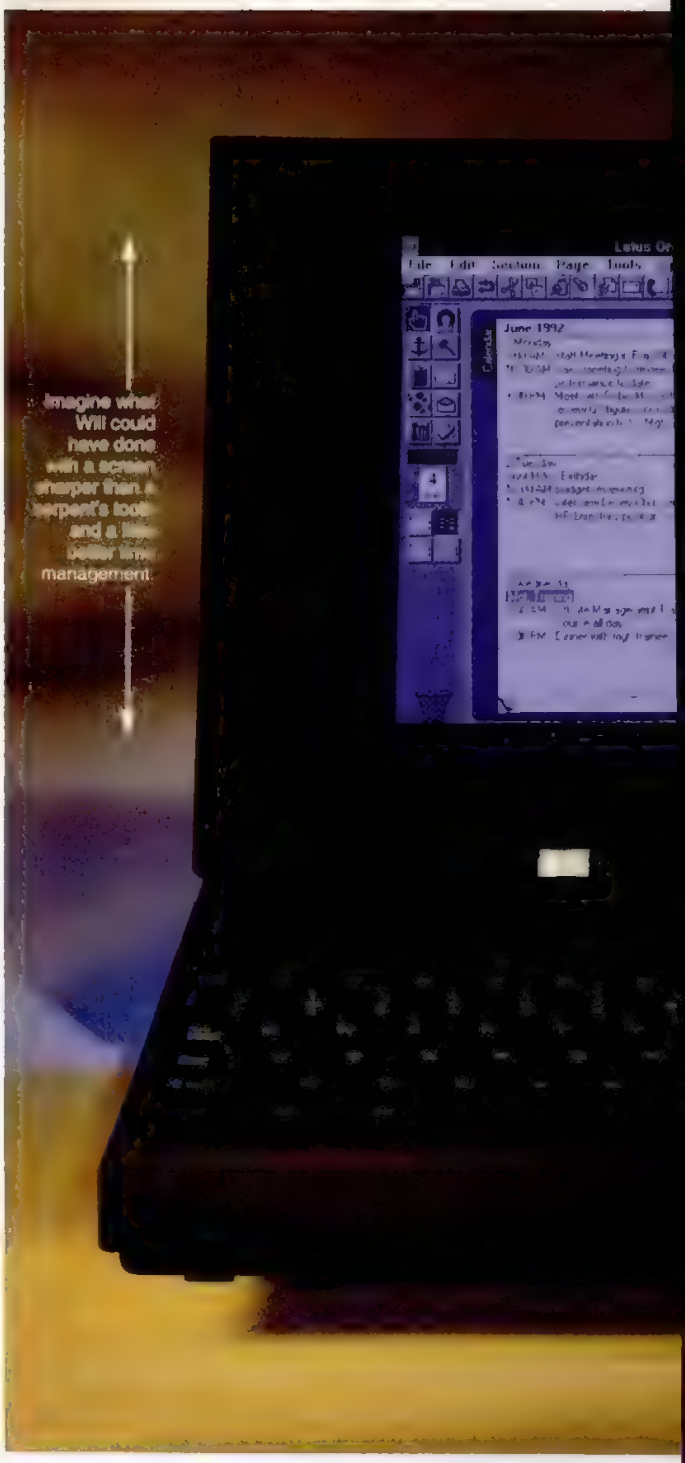

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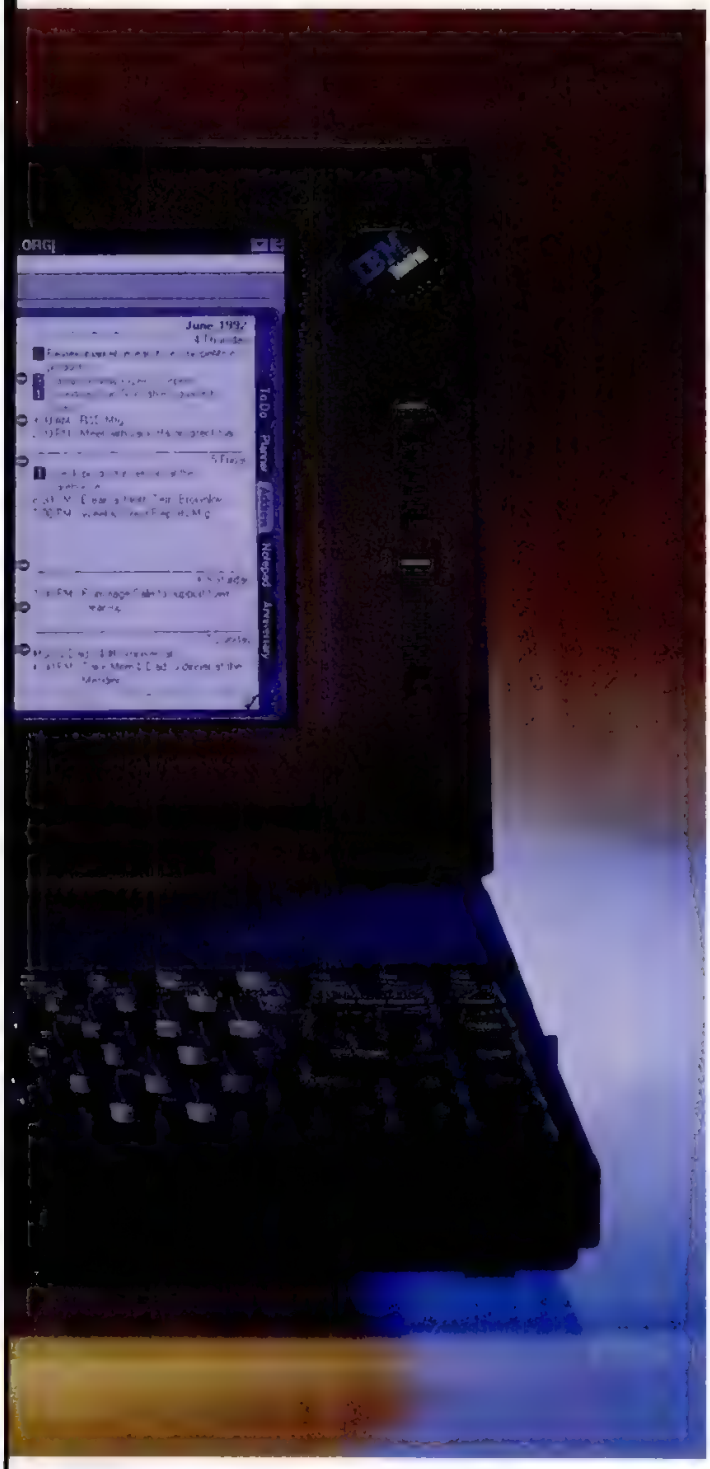

wide AC adapter and a port replicator, so you don't have to detach and reattach peripheral cables when you take your ThinkPad with you. There's an Ethernet LAN port right on the machine, with Data Only (2400 baud) and Data/Fax (2400/9600) modems available, too. The dual VGA connector lets you display on other monitors and keep the control right in your lap.

intel inside

ThinkPad	Model 300
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"Business users who need a wide variety of graphics functions shouldn't pass up this package. It is an amazing bargain."

Luisa Simone, PC Magazine, August, 1992

" CorelDRAW 3.0 is without doubt the most powerful, feature-laden, and best value for money graphics systems for Windows, at any price point. Full stop, end of discussion."

Jon Honeyball, Windows Magazine UK, August, 1992

"Endowed with paint, chart and presentation capabilities, this upgrade of the leading PC draw package is a stunning example of increased power at a reduced price."

Christina Wood, PC WORLD, July, 1992

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Mike Heck, INFOWORLD, July 13, 1992

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John Butler, Seybold Report on Desktop Publishing, July, 1992

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Michael Burgard, PC/Computing, July, 1992

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Aldus	Freehand	Persuasion	PhotoStyler	12	305	$1885
Corel	CorelDRAW!	CorelDRAW!	CorelDRAW!	256	14,000	$595

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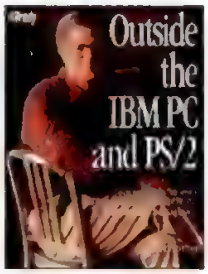
REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Peter Norton (and Friends) Reintroduces the PC

BY MATTHEW J. ROSS

It's hard to imagine where the computer book industry would be without Peter Norton. Not only did his 1985 work *Inside the IBM PC* introduce many of us to PCs, it also foreshadowed the powerful (and profitable) future of computer book publishing. Norton's latest work, *Outside the IBM PC and PS/2,* tackles the new territory of laptops, peripherals, add-ons, and the networking and telecommunications products that make up the rest of the PC market.



If you've ever felt over your head when reading a *PC Magazine* article, you'll find this book especially helpful. An excellent primer on the expansion market, it explains current technologies and peripherals and gives sound buying advice.

Norton's lucid explanations and analogies lay a foundation of knowledge on hard disk and expansion technologies, communications, modems, fax modems, networking basics, printing fundamentals, portable computers, and graphics hardware. A different chapter is devoted to each topic, as well as to security and encryption, graphics technologies, and emerging multimedia technologies.

But the book is not perfect. Norton—along with editors Scott Clark and Kevin Goldstein—adopted a committee approach, enlisting 11 additional contributors. Although Clark and Goldstein do an excellent job of providing a consistent, readable tone, the book lacks consistency in content.

The excellent coverage of communications ends with a reference list of books, hardware, and software, and the networking chapter concludes with a handy glossary. The other chapters lack these useful touches, however, demonstrating an overall lack of cohesion. And with no end glossary or other appendices, Norton's book cannot be considered a complete bookshelf reference.

Still, PC users seeking a solid introduction to the peripheral market, as well as some common-sense advice, will find Norton a fine place to start.

• *Outside the IBM PC and PS/2,* by Peter Norton, edited by Scott Clark and Kevin Goldstein, $29.95. Brady, 11711 N. College Ave., Carmel, IN 46032; 800-428-5331. ISBN:0-13-643586-6.

Circle 456 on reader service card

▪ New Life for Old PCs

There's a certain amount of satisfaction in finding new uses for old technology. So before you give up on outdated computer equipment, do some investigation. In *New Life for Old PCs* ($29.95 with disk, Business One Irwin, 800-634-3966), *PC Magazine* contributing editor Alfred Poor outlines economical strategies for getting the most out of your investment—from setting up an e-mail server to upgrading the hard disk to replacing the entire system. Poor also covers the market for used computers and lists organizations that place cast-off systems in schools and charities.—C.L.

Unlock Your PC's Power

BY BRUCE BROWN

If you want to understand more about computer performance and learn how to boost your own PC, buy *PC Power! Boosting Your PC's Performance.* Author Stephen J. Dougherty's clear, concise, and relatively current book is a terrific resource for helping you break through the bottlenecks.

PC Power! is neither an insulting elementary primer for computer novices nor a thousand-page reference. In 300 pages, the book covers what's important so you can take what you have and make it better.

To explain how system components interact, Dougherty constructs a performance model based on *bandwidth*—the amount of data handled during a given period of time, measured in megabytes per second. Ranked by decreasing bandwidth, the order of components is: CPU, RAM cache, main memory, I/O bus, disks, video, parallel I/O, serial I/O, keyboard and mouse, and user. (Even the most facile user pokes along at a mere 6 bytes per second.)

The book examines each component and emphasizes the increase in performance at each step. The information is accurate and more current than publishing cycles usually allow, covering such topics as Intel's 66-MHz 486DX2 and IBM's 486SLC2 processors, local bus I/O, and video coprocessors and accelerators.

The strongest sections are on optimizing hard disk performance and on configuring systems to work best in specific applications, including Microsoft Windows 3.*x*. Upgrading hardware is recommended only when the performance payback is worth the money.

PC Power! is not the ultimate computer reference work, but it's one of the best books available for users who want to understand and pump up PC performance.

• *PC Power! Boosting Your PC's Performance,* by Stephen J. Dougherty, $26.95. M&T Books, 411 Borel Ave., San Mateo, CA 94402; 800-688-3987. ISBN: 1-55851-250-0.

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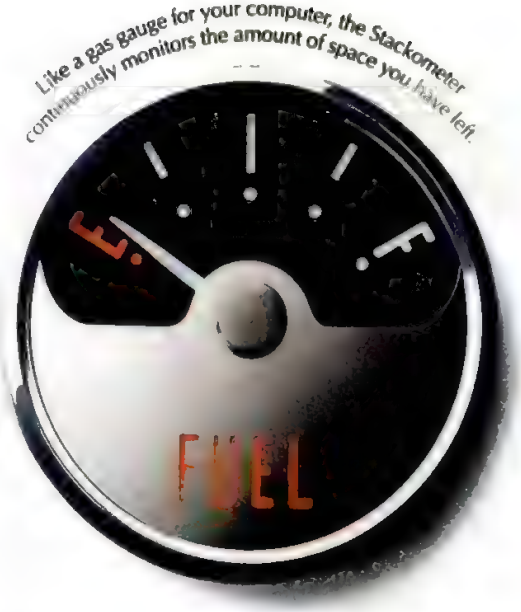
Stacker works with portables and laptops, which is one of the few ways to increase their capacity.



Like a gas gauge for your computer, the Stackometer continuously monitors the amount of space you have left.

Stacker is so advanced, it even works in places where it doesn't exist. Because once your removable disk is stacked, you can read from or write to it anywhere, even on a PC that doesn't have Stacker.

For the perfect combination of compression and speed, use the Stacker Tuner.™ Normally, Stacker gives you a compression ratio of about 2:1. With the default setting, you can get maximum speed. But by simply tuning the settings, you can increase disk capacity by up to 10%. So on a 200 meg drive, that means an extra 40 megs of space.

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The only place where we might run out of room is on our trophy shelf. In less than two years, we've won every major award in the industry. Including PC Magazine's Editors' Choice and Windows Magazine's WIN 100.

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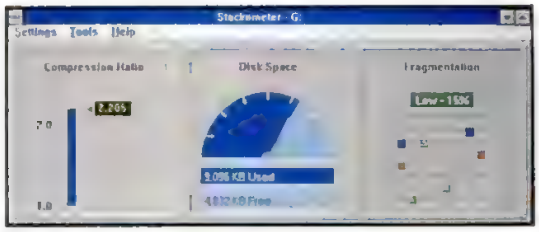
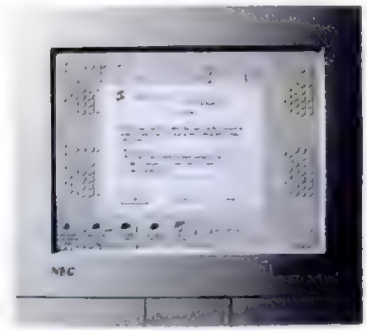
On all stacked drives, you can set double passwords, one for read/write and one for read-only access. With read/write, users who don't know your password have no access to your data. With read-only, they can see the data but are unable to alter it.



In addition to your available space, the Stackometer™ also shows you your compression ratios and fragmentation levels for all of your drives.

If you use our Express Setup, just insert the disk and press return a few times and you're done. With the Custom Setup, you can adjust Stacker to fit your exact needs.

You can double your disk capacity on the full range of hard drives, all the way up to 2 gigs. As well as on floppy drives, Bernoulli™ disks, SyQuest™ cartridges, optical and floptical drives, and memory cards.



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In explaining what our new software does we ran out of space.

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Once upon a time, all faxes looked the same. *Bad*. But with the Silentwriter® Model 95fx multifunction printer/fax, nothing gets lost in the transmission. Imagine PostScript™ language–quality *faxes* from your printer. It's no fairy tale. Now you can send and receive documents in all their original glory. You'll see beautiful fonts and graphics with none of the dirt and glitches, the jaggies and imperfections, that can turn a wonderful story into a tragedy. Why send a facsimile when you can send an original? Get the NEC Silentwriter Model 95fx multifunction printer/fax and live happily ever after.

The End

Actual facsimile generated from a Silentwriter Model 95fx.

November 24, 1992
NEC Silentwriter Model 95

1992
Printer Of The Year
Silentwriter Model 95

"...all the PostScript printer you'll ever need."
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And these facts.

1. A state-of-the-art 6 PPM laser printer equipped with the latest in Mac® and PC® printer software support—Adobe's PostScript™ Level 2 and HP's PCL5.
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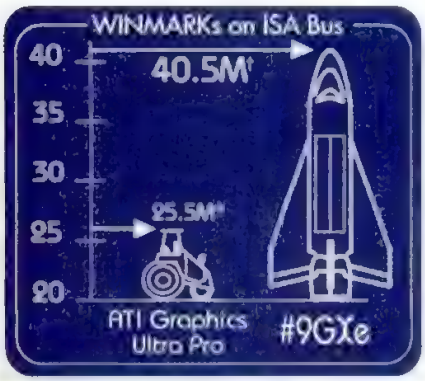

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And it's priced to fly.

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Toolkits

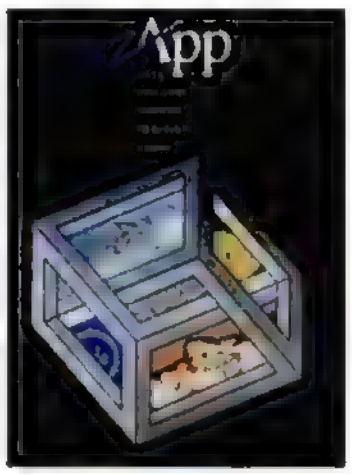
REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

zApp: Not Just Another Application Framework

BY RICHARD HALE SHAW

If you write Windows applications with C++, you already know what an application framework is. And if you own either Borland C++ 3.1 or Microsoft C++ 7.0, you already have either ObjectWindows Library (OWL) or the Microsoft Foundation Classes (MFC).



So why would you want to consider yet another application framework for Windows and C++?

First, neither MFC nor OWL offers a DOS counterpart for its application framework. (Borland offers TurboVision for DOS, but the program is incompatible with OWL.) Second, both MFC and OWL are Windows-specific; and while MFC for NT is in beta, as is OWL for OS/2, neither will support *both* platforms anytime soon.

Third, neither MFC nor OWL lends itself to working with other compilers: MFC's use of Microsoft C++'s based pointers makes it difficult, and OWL's use of an extension to the C++ pure virtual function syntax that only Borland supports makes it impossible.

And finally, both OWL and MFC require that you have more than a minimal understanding of how Windows works in order to use them.

These limitations vanish with the arrival of zApp, a $495 package from InMark Development. zApp offers an elegant, eloquent means of writing a single set of source code that can be compiled for DOS character mode, Windows, and Windows NT. At press time, InMark said it plans to ship DOS graphics-mode and OS/2 versions this year. In addition, zApp supports Borland C++ 3.*x*, Microsoft C++ 7.0, Zortech C++ 3.0, and Borland Turbo C++ for Windows in one package. Best of all, zApp doesn't require that you know how to program Windows before you use it.

How portable is zApp code? As long as you write your applications using zApp objects, you can create programs for one compiler or environment and recompile them with another compiler for a different environment without any changes. zApp uses Magma System's MEWEL to ensure that the Windows-specific code can be ported to DOS. You cannot, however, port code to DOS that uses Windows GDI calls, and the DOS applications that you create tend to be quite large: A zApp Windows executable was 71K and grew to 272K when it was recompiled for DOS. The reason? Every DOS executable that you build with zApp has to include code for the windowing functionality that's provided by Windows.

Unlike OWL and MFC, which require that you forge a link between class member functions and their associated Windows messages, zApp hides Windows-specific aspects of message handling. zApp encapsulates every event or message into an object built from class zEvent, which is sent to an event dispatcher; the latter then calls virtual member functions of the event-handling class, zEvH. You can change the default event-handling behavior by deriving new classes from zEvH and overriding the virtual member functions.

The downside of this approach is that every class you derive from the zWindow class will inherit a C++ *vtable* of virtual function pointers, and this—in addition to the search made through each *vtable* when a virtual function is called—can add overhead to your application.

I'd have preferred it, too, if they had used more descriptive member function names: paint() is not as clear as WMPaint() or PaintWin() or OnPaint(). However, instead of linking a member function to the WM_PAINT message (as you must do in MFC or OWL), you only have to override the default paint() member function that's inherited from the zWindow class. The result is that you can create an event-driven application that you can run on *any* platform—not just Windows.

If you're a novice Windows programmer, you're sure to find learning zApp's event-driven object-oriented programming model simpler than learning to program Windows in C or with OWL or MFC. zApp comes with an excellent step-by-step tutorial that includes 44 sample Windows programs and 19 sample DOS programs. Unfortunately, while zApp may speed your Windows development, you won't gain Windows programming experience.

zApp encapsulates the Windows API, objects, and message handling so comprehensively that you won't even know you're programming Windows. With over 120 classes in its object hierarchy, zApp offers more than 5 times as many objects as OWL and 50 percent more than MFC. Some of the objects zApp offers that are not available in MFC or OWL are classes that perform clipboard I/O, manipulate bitmaps (read and display them from a file), manage memory and timers, and a class to superclass an existing window.

zApp lacks classes for implementing DDE and OLE (MFC has an OLE class but not one for DDE; OWL has neither), and there are no classes for creating persistent objects. InMark says that all of these functions will be included in its next release.

Still, zApp's object hierarchy remains the most comprehensive I've yet seen in an application framework. I'd wholeheartedly recommend zApp to beginning Windows developers or C++ developers at any level of experience. Hard-core Windows developers who use C may find the layers of abstraction frustrating and might be better off looking at MFC, but experienced Windows developers who have already been convinced of the benefits of OOP are sure to find it refreshing. □

• zApp for DOS and Windows, Version 1.1

List price: *$495; $295 Windows only; $195 Windows only without source; $395 Windows NT.*
Requires: *DOS 3.x or higher, Windows 3.x or higher, 1.5MB hard disk space. InMark Development Corp., 2065 Landings Dr., Mountain View, CA 94043; 415-691-9000.*

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August 1992
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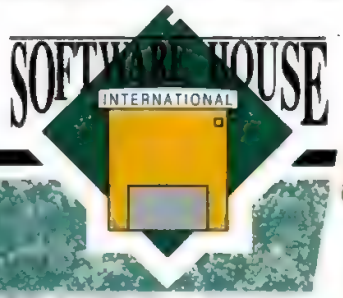
Software House and Microsoft Introduce Windows for Workgroups



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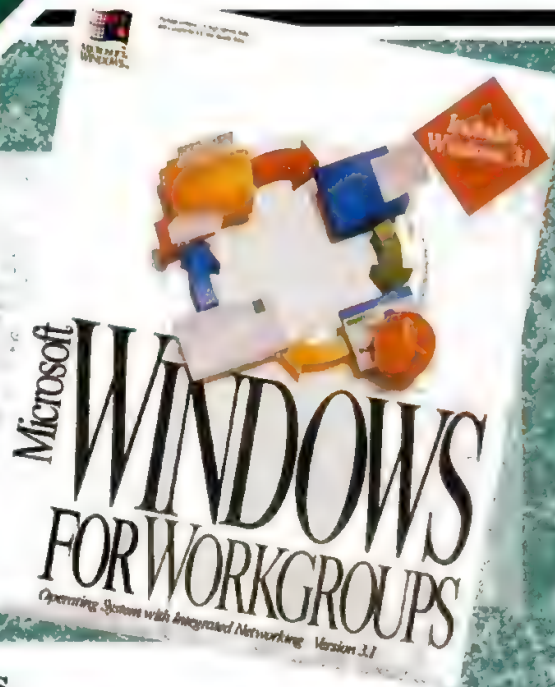
$149 Upgrade from DOS



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Michael J. Miller

Two Paths Diverged

IBM and Microsoft have seen the fork in the road to the next-generation operating system, and they have chosen different paths. IBM sees its vision clearly and is hustling to get there as fast as possible. Microsoft, in contrast, is taking the longer road, moving ahead one step at a time.

This is not how I usually think of these companies, but it's the impression I had after hearing IBM and Microsoft spell out their respective strategies for developing operating systems.

IBM presented a long-term vision, designed to put into place its three operating systems: DOS, OS/2, and its AIX version of Unix.

It plans a fair number of improvements to DOS, including better support for portable devices through new power management features and the ability to run from ROM. IBM wants to beef up DOS's ability to run as a client in client-server operations and wants to add a new user interface—a variant of the OS/2 Workplace Shell. At the same time, IBM is planning several smaller upgrades to OS/2 2.0. By the time you read this, a new version with a number of bug fixes and the long-promised 32-bit graphics engine should be available, and a version providing support for Windows 3.1 applications should be on the way. IBM also plans to improve OS/2's performance on smaller machines.

The real changes, though, will wait until the next major version—probably called OS/2 3.0—which will be a significant departure. (Bill Machrone examines IBM's long-term strategy in this issue.) Essentially, it will be based on a derivative of the Mach 3 microkernel, created at Carnegie-Mellon University. On top of this kernel will be an array of additional features, including real multiprocessor support and better security. One key feature of the kernel, and of OS/2 and other operating systems based on it, is its support for multiple hardware architectures, including the Intel family and IBM's PowerPC architecture.

The same microkernel is also at the center of IBM's AIX strategy for the PC, designed to be IBM's highest-performance operating system. This Mach 3-based version of AIX will take features from the versions of AIX currently running on PCs and workstations. The operating system will continue to take advantage of the open systems in the Unix arena but will also add systems management, object management, multimedia features, and—as part of the company's relationship with Apple—support for the Macintosh desktop.

Notably, OS/2 and AIX won't be all that different. In fact, each will include the microkernel plus a framework of additional modules. OS/2 2.0 and AIX will be just two multiple "personalities" within those frameworks. While these two systems are likely to be the dominant personalities, you would be able to install and run applications for other personalities as well—perhaps DOS, Windows, Macintosh, or OSF/Motif. (Interestingly, 16-bit OS/2 is not one of the personalities IBM is planning.) When you select an application, the APIs and user interface for the chosen personality that runs the program will appear. This makes it easy to mix and match applications from multiple environments.

Indeed, the major benefit of this strategy, according to IBM director of software architecture, Larry Loucks, is its object-oriented building-block approach. This lets you add to the system in pieces—such as support for new hardware architectures, new object-centric technologies like those being developed by Taligent, and new personalities—without changing the core operating system. In the same way, you could remove any of the personalities and clear out the baggage left behind by older operating systems if you decide, say, that you don't want to run DOS or Windows applications. Eventually, you could replace all the personalities

In the quest for the corporate desktop, IBM and Microsoft have mapped out fundamentally different strategies.

Illustration by Mark Matcho

by a completely object-oriented system, such as the one Taligent is planning.

IBM's plan ties together the threads of various operating systems strategies it has been discussing over the past few years. In keeping with current operating-system theory, the plan stresses object orientation. That is, the way the OS/2 System Object Model encapsulates applications and how the Workplace Shell works. Just as important for IBM, this approach would enable the system to be customized fairly easily for unique hardware. And except for the final Taligent operating system, IBM plans to deliver all this within the next 12 to 18 months. It's a big task, and certainly one that sounds intriguing.

MICROSOFT'S SMALL STEPS

In striking contrast, the future looks quite different out on the West Coast. While past Microsoft strategy sessions focused on the long term, this one clearly centered on this year's product: Windows for Workgroups.

This is a bit of a surprise, since Windows NT has gotten a lot more attention over the past two years. But NT's biggest technical advances over the DOS/Windows duo are based on its being a 32-bit, multitasking, multithreading operating system—advances that OS/2 already implements. Yes, NT will have other features, such as multiprocessor support and better security, but today those features are interesting primarily on servers, not on desktop PCs.

Windows for Workgroup's messaging and scheduling capabilities and network Dynamic Data Exchange may not be as sexy to programmers, but they can certainly be demonstrated easily to end users. Of course, Microsoft says NT will also have these features.

Microsoft is following an incremental approach: DOS to Windows 3.0 to Windows 3.1 to Windows for Workgroups to NT. It's taking object orientation one step at a time as well, at least for end users. Microsoft downplayed its long-term Cairo project, intended to bring more object-orientation to the desktop and file system. Instead, it concentrated on the next version of Object Linking and Embedding. The demo I saw showed how OLE 2.0 allows editing in place: Click on a chart in a Microsoft Word document and see the entire document appear in CorelDraw. It's similar to Ami Pro's in-place editing, but expanded into the operating system.

Again, this is part of an incremental approach: OLE 1.0 to OLE 2.0 and then, perhaps, to Cairo. Microsoft's approach is not as fast or as radical as IBM's approach, but it does allow both users and developers to advance their applications gradually and generally maintain compatibility.

In short, IBM is focusing on the longer term, Microsoft on the intermediate steps.

IBM's strength is in its vision. Its weakness is that by focusing on the future, it may not bring as much to the table today. People buy operating systems and environments for the unique applications they run. So far, OS/2 hasn't delivered those applications.

Microsoft's strength is in the growing base of Windows applications and committed Windows developers and in maintaining compatibility. Its weakness is the possibility that OS/2 or one of the many Unix variants (Solaris, NeXTstep, UnixWare, or SCO) will race ahead and become immediately attractive to customers.

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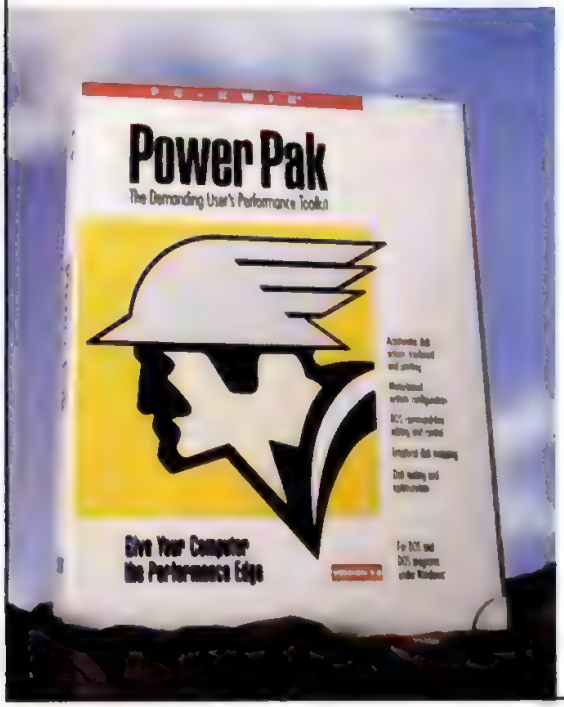

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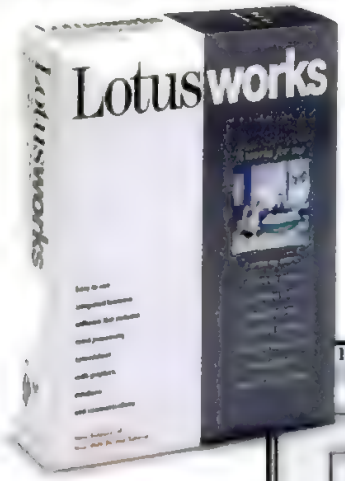

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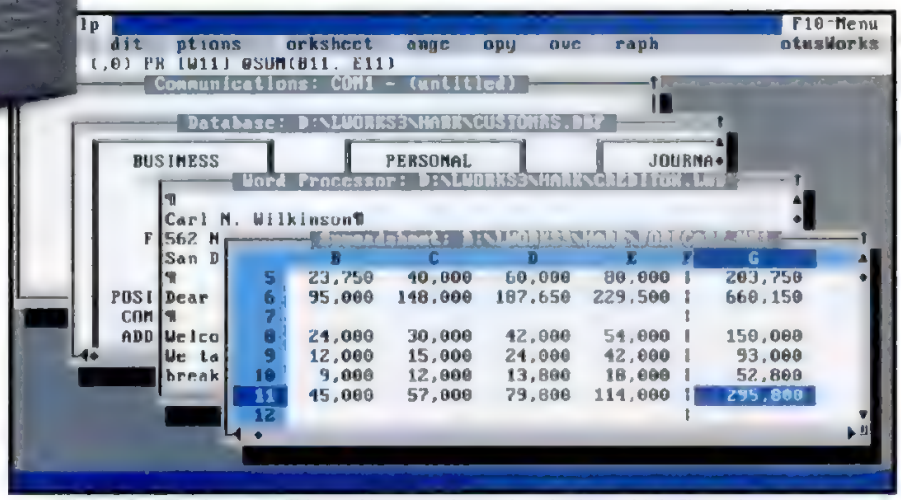

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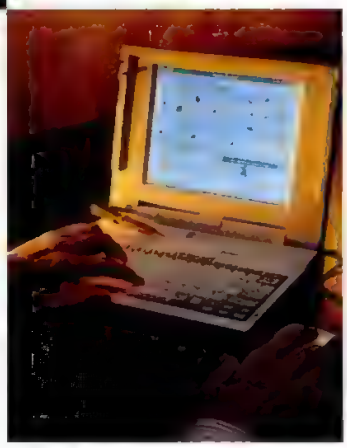

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Bill Machrone

The OS/2 Game Plan

I remember playing center field in the empty lot across the street from our house when I was young. The kid at bat was pulling every pitch past the right foul line, and the right fielder wasn't enough of a gambler to go stand beyond the baseline and wait for one to drop into his glove. I spent the time shooting the breeze with the second baseman, who had wandered out to my position. Together, we watched a hornet land on, then crawl into, an old tin can. We laughed as my buddy raised his foot over the rusty remains of the can, and joked about there being one less hornet in the world. He brought his foot down, and a steel-blue cloud of vengeful hornets spewed forth. We spent a rueful afternoon nursing our stings, which my mom had daubed with some homemade poultice.

I stirred up a similar furor back in my September 29 column, "Kiss and Make Up." I suggested that IBM should get solidly behind Windows NT because, unlike OS/2, it had a clearly articulated future. You can imagine the resulting storm. It made me wish I had some of my mom's poultice. After the swelling went down, we met with key people at IBM who explained the long-term OS/2 strategy.

Now that I've gotten over my surprise that there *is* a long-term OS/2 strategy, I have to admit that I'm plenty impressed. Windows NT is disappearing into the deepening gloom of development delays and unavailability, while IBM is casting ever-longer shadows of competence, forward thinking, and achievable goals. Here's the story.

IBM already has a world-class operating system in AIX and, as I pointed out in my previous column, owns or has licensed virtually every meaningful alternate operating system technology out there. Everyone recognizes that object orientation at the operating system level is crucial to future growth, productivity, and performance. IBM will join the ranks of Apple, Microsoft, and others in developing the next generation of desktop operating systems.

IBM has revealed its long-term game plan for OS/2. It's a cross-platform strategy with real deliverables.

First you'll see an object-oriented version of AIX, complete with the Workplace Shell, IBM's oft-praised object-oriented, drag-and-drop user interface. This new version of AIX will be built on Carnegie-Mellon's Mach 3 microkernel. The Mach kernel (also the foundation of NeXT's operating system) is one of the most advanced operating systems out there, touting portability, high performance, and modularity. Symmetrical multiprocessing is built in.

Then look for OS/2 to split into two code bases, one that continues and extends today's code but is fully 32-bit. That'll be the low road. At the high end, OS/2 will also be built on the Mach microkernel. Of course, it'll run the same APIs as today's OS/2, in addition to future APIs derived from the Workplace Shell and object work that's going on at Taligent. It's not beyond the realm of possibility that OS/2 would also have a Win32 API, so that it would run Windows NT applications. This would be a neat turning of the tables on Microsoft, and would ensure that Microsoft would respond by offering either Presentation Manager for NT or a version of the Workplace Shell. By the way, you can also expect to see a Workplace Shell for Windows from IBM.

The microkernel architecture confers some enormous benefits on both AIX and OS/2, making them portable across multiple platforms. Expect to see both running on Intel chips, IBM's Power (RS/6000) architecture, Power PC (IBM/Motorola collaboration), and some other (very) popular RISC chips. Also, the operating system will start to behave more like an application and will interact more heavily with applications.

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communications, server capabilities, device drivers, and messaging systems. It'll be tied together by IBM's System Object Model (SOM), covered by half a dozen pending patents. SOM is broader in scope and more powerful than other object-oriented development environments, such as Visual Basic or ObjectVision. SOM puts objects in the hands of the operating system, which is where they belong. Back in the early days, DOS didn't know how to do memory management, so the industry tacked on EMS. It's the same way with objects. Today, they're born inside compilers and are sent out into the world to interact with applications. There's a limit to how much they can do without a trip back to the compiler. SOM intends to change that.

Throughout all this, symmetrical multiprocessing is still a year or more away. Expect SMP to hit file servers and desktops in a big way in 1994. It'll take that long for the hardware and the software vendors to sort things out.

SOUNDS ROSY, BUT...

IBM remains in a deep quandary. Historically, it has had the finest information scientists in the world. Its personal computer arm has been high-priced and reactive, and its software efforts have been late and unfocused. The first remains true: IBM doesn't take a back seat to anybody in operating system and database development. We've seen a Herculean effort to turn the PC business around, and early indications are that it's working. In software, IBM is up against Microsoft, which is masterful at making its version of the future sound both exciting and inevitable. IBM's frustration is plain. As one IBM executive said in a recent meeting, "If you have nothing new [to talk about], you're a jerk. If you do, you're still a jerk." This Rodney Dangerfield attitude toward it is directly attributable to the number of times IBM has changed strategies in the recent past. Now it has a long-term strategy with realistic, interim deliverables. It's time for some respect.

IBM is not a jerk. It's a big, diverse set of companies and divisions that has not been pulling in unison, much less hitched up to the same wagon. That's changing as we speak. There will always be diversity at IBM, but at last there's an operating system strategy that I admire. In my earlier column, I called for a consistent operating system (that wasn't AIX) across at least two platforms. We'll finally have that, and more. □

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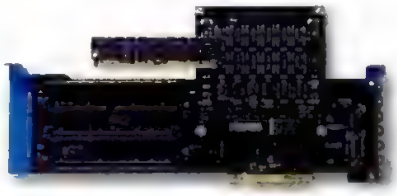

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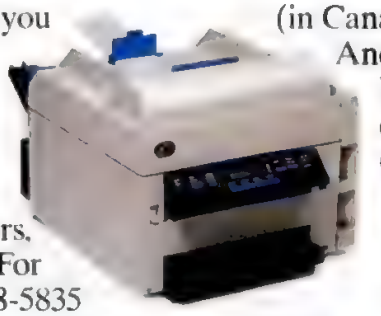

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Modem a memo to a client; send and retrieve your e-mail. With the Pocket PC's optional fax/modem, you can communicate worldwide. Plus, expanding the memory is another easy option—with an additional memory card that slips right into a slot on the system's underside. And that's not all.

IT JUST KEEPS GOING...

Ten hours of continuous use? Absolutely! All it takes is the two AA alkaline batteries included with your system. And your ZEOS Pocket PC has great power management, too—it automatically switches to the suspend mode when you take a break. Plus, when you turn off your system, then turn it on again, it goes right back to where you left off. What a time-saver!

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CIRCLE 125 ON READER SERVICE CARD

John C. Dvorak

Screwball Sales Gimmicks

I laughed when I first saw IBM trademark the term "Crash Protection" and then use it as a sales gimmick for OS/2. After all, what kind of nonsense is this? All programs have error handling. That's all Crash Protection is. Right? OS/2 is much better than average, but the program is not crash-proof! I stopped laughing when more than a few readers wrote that the reason they tried OS/2 was because of its Crash Protection. "It's very appealing to me," said one reader. The more I thought about it, the more I realized that a lot of people would find it appealing. It's because they don't know any better.

Proclaiming the obvious and then trademarking it is silly. How can you trademark "Crash Protection?" It's like trademarking the words "Office Desk." But as a marketing gimmick, IBM may have stumbled onto something: turning obviousity into a feature. Unfortunately, if taken to extremes it will lead to these ideas:

• ***New Flip Switch (tm) Technology***. "Immediately after you turn on your computer with the simple flick of a switch, OS/2 will load automatically! No hassle! No muss! No fuss!"

• ***Screen Magic (tm)***. "Unlike other operating systems, Screen Magic fills your monitor with a programmable brightly colored background. Allows you to use the full screen not just part of it!

• ***Installation Expedition (tm)***. OS/2 installs in less than an hour! Easy-to-use disks are conveniently numbered. No more guessing!

Once these ad campaigns roll out, other software companies will copy the idea.

From Microsoft we can expect:

• ***DOS-based (tm)***. "Unlike copycat programs or DOS substitutes, Windows is ***DOS-based (tm)*** for extra added power and flawless compatibility!"

From WordPerfect we'll see this one:

• ***Versatile Block Move (tm)***. "No more retyping long sentences. With WordPerfect's Versatile Block Move you can highlight a letter, a word, a sentence, or *more* and move it to another part of the document! ***Versatile Block Move*** is an exclusive of WordPerfect."

From Lotus we'll see:

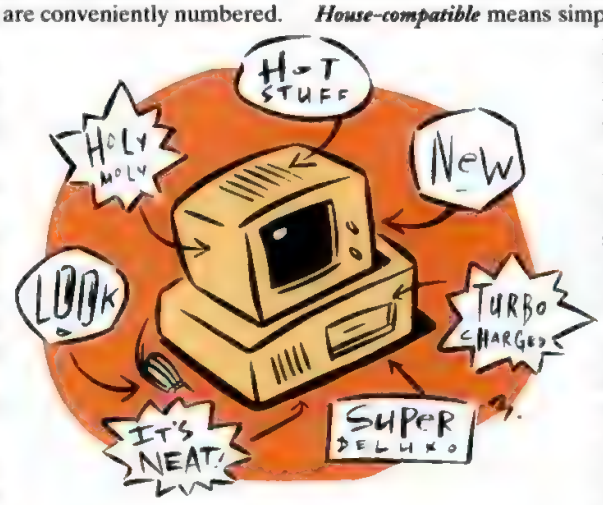
• ***Keypad Entry (tm)***. "Lotus 1-2-3 lets you enter numbers from the numeric keypad! No more fumbling with the number keys across the top of the keyboard."

As you can see, the ad copy is designed to make a newcomer (a rube) think that other programs don't have these features when, in fact, they *all* do. This will degenerate into wild claims that imply all sorts of inconvenience. This might come from Borland:

• ***Two-hand Speed (tm)***. "Now available with all Borland Products. No longer tie up your left hand with hard-to-press key codes. No foot switches, headgear, or other unnecessary inconveniences. You simply type with two hands! What could be easier?"

Or, if a hardware company gets into the act:

• ***House-compatible (tm)***. "When you buy a Compaq computer you can plug it into any standard household 120-volt socket. No special wiring needed! No need to call in an expensive electrician just to get your computer to work. No need for any special or expensive socket. ***House-compatible*** means simplicity and versatility. Now you can move your computer from room to room or from office to office without fear!"



Proclaiming the obvious and then trademarking it is a new marketing ploy. Don't fall for it.

All this is ridiculous, but not much different than Crash Protection as a sales point. Hopefully, the trend will end with IBM and Crash Protection.

We can't overlook the simple fact that computers still mystify most people and that newcomers would actually believe many of these joke trademarks. We have to remind ourselves that the average American is still *not* computer literate. It's our job to educate the newcomers, not bamboozle them.

Illustration by Mark Matcho

A MAP FOR ALL REASONS...

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MS WINDOWS

MS DOS

Most business people still use maps for things like planning vacations and teaching geography to the kids. At Strategic Mapping™ we're helping people use maps to enhance their business decisions. By linking maps to a database or spreadsheet on a PC or

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CIRCLE 221 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Never-ending Progress Dept.: A couple of months ago Intel preannounced its **P6 microprocessor,** saying it will be ready in 18 months. With a slew of RISC chips about to hit the market, Intel feels the need to make **promises** for the future to keep the Intel juggernaut alive. Look for a **P7 announcement** before the end of 1993.

This is amusing since the P5 (Pentium) hasn't yet shipped. The specs on the P6 are mind-boggling. It contains **10 million transistors.** By comparison the 486 has 1.2 million and the Pentium is expected to have 3.1 million. This chip will give developers the opportunity to produce even more **inefficient bloated code.** What a future!

To keep the Intel juggernaut alive, Intel preannounced the P6. It's got a mind-boggling 10 million transistors. Intel also plans to drop a cool $400 million into plant expansion.

To further **scare** the competition (aka AMD), Intel says it will drop a cool $400 million to expand its fabrication plant in Santa Clara, Calif. This is particularly interesting since, according to news reports, it's the industry's first substantial plant improvement done in the Silicon Valley mini-kingdom in nearly a decade. Nowadays **Silicon Valley is a virtual reality.** Most of the chip making is scattered around the country.

Those Crazy IBMers in Japan Dept.: From Japan watcher Bill Smale comes the latest on IBM's attempt to **penetrate the Japanese** PC market. He says things are hopping there for IBM. About a year and a half ago, IBM set up a new group in Japan, the OADG (Open Architecture Development Group), to create and standardize on a version of DOS that contains the Japanese character set (JIS I and JIS II) in software instead of hardware. This enabled imported AT compatibles to run in Japanese without the Japanese character set in ROM. This is an attempt to finally **sink the ill-fated AX standard** dreamed up by Microsoft.

At the time of the IBM incursion, **only 8 hardware** manufacturers, including Sanyo, Oki, Sharp and Hitachi, were still supporting the AX standard. I think in the early going there were 20 to 30 vendors signed up. The AX was developed mostly by Microsoft and consisted of a basic AT with the Japanese character set in ROM. Its display was the J-EGA.

While a slew of glad-handers jumped on the early AX bandwagon, NEC continued to **dominate** Japan anyway. NEC uses an incompatible MS-DOS to do its job. While this still means licenses for Microsoft, it also means a **small uncompetitive** market. Microsoft wanted more sales to sell more licenses, thus AX.

As the AX project shriveled, IBM saw a chance to take a leadership position in establishing a standard that would allow improved desktop performance and open up the market for imported clones. The result of this was a version of DOS called "DOS/V". There is **already a Windows 3.0 for DOS/V.** In the process, IBM stepped a bit on its own feet, too. IBM was selling their own J/DOS for their PS/55 series in Japan. The PS/55 was based on the PS/2 standard and included a Japanese-character ROM. It is a descendent of the odd IBM 5550 sold only in Japan and essentially incompatible with everything else. IBM introduced J/DOS for that series of PCs. J/DOS is essentially being phased out in favor of DOS/V.

At the moment there is a **lot of confusion over all this** and I'm sure I'll get a few letters telling me how this analysis is wrong. Smale believes IBM wants to keep 'em guessing.

We Get Letters Dept.: From Jim Ryan of Ryan Associates comes some commentary about my Buzzwords column. *"Buzzwords, Oh, great! Now we've got OODLs of OOUI, GUI, BLOBs! VROOMM! (OOPs, my last MOD SQL'd our QBEs; OLE!) Borland ought to get the acronym of the year award for obfuscating the entire industry!"* Amen!

Item two comes from Marty Winston, "The postal service wants to deliver e-mail, but they haven't figured out a way to slow down electrons enough." Maybe they should consult the Union! (Just kidding!)

Genuinely Interesting Software Dept.: Here's one of those practical programs that I suppose you or I could program if we really wanted to (or had the time). It's called Leaseit!—The Automated Leasing System. Normally $49.95, Chart Software is selling it for $35 for a limited time (Chart Software, 152 Woodcreek Dr. North, Safety Harbor, FL 34695; phone, 813-733-4860). This is **more than** one of those simple lease/buy programs. This is an elaborate lease calculation system designed to get you the **best deal** on a leased car and help you understand what **shenanigans** the dealer is trying to pull (if any). Install it on a laptop and go into a dealership next time you lease a car. You'll find that the $35 charge is quickly paid for by savings you obtain from knowing what you're doing. That's unless they toss you out on your ear! Chart Software throws in a free copy of the Pace wholesale car price guide too. **Such a deal!**

Trend to Watch Dept.: Mark your calendars. 1993 will be the year that the **600 dpi laser printer becomes standard.** The enhancement products will probably double that resolution. Also look for a couple of attempts at small color laser printers next year. □

Get a better de on a better 1-2-

Now that's good news for anyone buying a Windows™ spreadsheet. First, we recently updated 1-2-3® for Windows so it now gives you more of the features you've been looking for in a Windows spreadsheet. Second, we lowered the price to just $495.* (Plus, for upgraders, and for a limited time only, we've included the SmartPics™ Clip-art Sampler absolutely free.)

$495

Of course, when you come right down to it, there are plenty of other reasons why 1-2-3 for Windows is the best spreadsheet choice you can make.

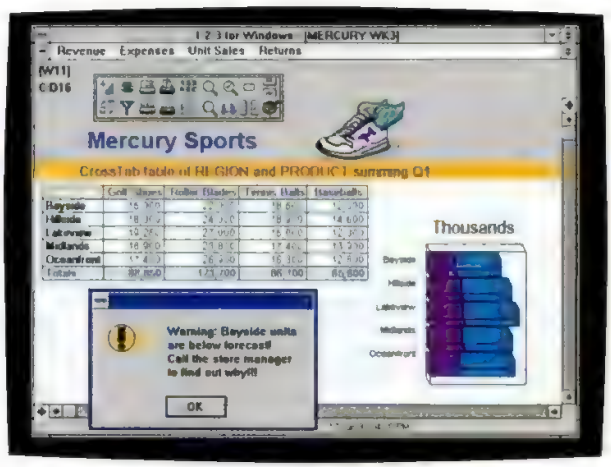
Its features and performance are better than ever.

1-2-3 for Windows now includes more than 25 new features and usability enhancements, as well as a robust set of GUI development tools.

Recent performance enhancements also make 1-2-3 for Windows the fastest-printing Windows spreadsheet for Postscript® output. It also makes the most efficient use of system resources when handling 3D files.

Better still, we're offering license packs for network users so you can set up your network configurations more cost-effectively. All of which makes Lotus® 1-2-3 for Windows the best deal in a Windows spreadsheet.

It's a better transition from DOS to Windows.



Only 1-2-3 for Windows, with its built-in Classic® Menu, lets you use familiar 1-2-3 commands whenever you choose. Excel, on the other hand, only supports 80% of 1-2-3 Release 2.01 commands. And has no support for releases beyond.

*Suggested retail price. **In Canada, call **1-800-GO-LOTUS.** Eligible spreadsheet products include 1-2-3, LotusWorks, Symphony,® Microsoft® Excel and Quattro® Pro. Please have your credit card and product package ready when you
Lotus, 1-2-3, DataLens and Symphony are registered trademarks and SmartPics and Multimedia SmartHelp are trademarks of Lotus Development Corporation. Classic is a registered trademark licensed to Lotus Develop

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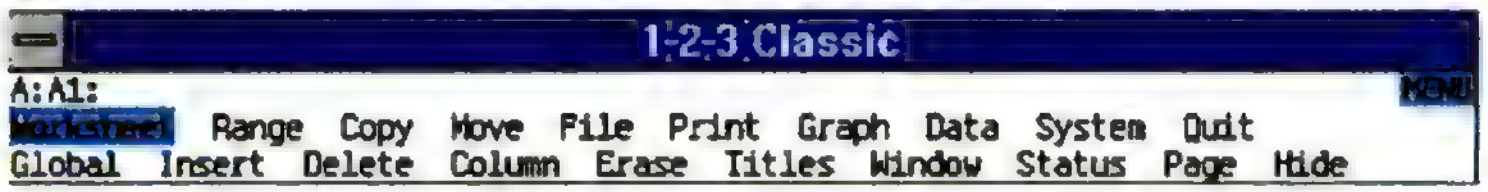
What's more, only 1-2-3 for Windows offers



you a better compatibility bridge from DOS to Windows. And unlike Excel, 1-2-3 can read and execute *any* 1-2-3 for DOS file, style and macro.

All of which means you'll retain your full investment in 1-2-3 for DOS files when you move to 1-2-3 for Windows.

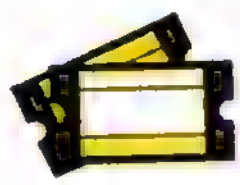
Its 3D technology and external data access capabilities are better than Excel's.

In 3D technology, 1-2-3 is unsurpassed. It gives you easy access to 256 worksheets and lets you build true 3D formulas. Excel's Workbook is a mere imitation. That makes 1-2-3 for Windows a more powerful tool that truly helps you consolidate data, spot trends and make better, more timely business decisions.

Corporate Computing (8/92) wrote that *"for the experienced 1-2-3 database user, 1-2-3 for Windows with DataLens® is the front-end tool of choice."* Excel's data access capabilities rely on a third-party product with limited relational capabilities.

There's no better time to act than now.

Remember, for a limited time only, when you upgrade to 1-2-3 for Windows, we'll give you a SmartPics Clip-art Sampler absolutely free. It includes over 100 clip-art images to help you better communicate through your spreadsheet; it'll do the same with any Windows application.



Of course, we still offer our unique Technology Guarantee which allows you to upgrade for just $49 to any new version of 1-2-3 that is introduced within six months of your purchase.

So if you're ready to take advantage of this great upgrade offer, just see your Lotus Authorized Reseller or call **1-800-TRADEUP, ext. 7172.****

Lotus **1-2-3 for Windows**

call. Offer expires 12/31/92 or while supplies last. 1-2-3 for Windows is also available on CD/ROM, with Multimedia SmartHelp.™ © 1992 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. All rights reserved.
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"For professionals, Illustrator 4.0 for Windows is an exceptional do-it-all application..." InfoWorld, 1992.

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Jim Seymour

The Little Things Mean a Lot

It was a good year for *stuff*. Not hot new PCs, but the little things that make working with a PC a lot easier. Sure, we saw the first 66-MHz 486DX2s, some decent color portables, and sharply lower PC prices. And this year the Windows-OS/2 War heated up. But what was really interesting about the new-product side of the PC business this past year wasn't the boxes themselves but the things we put in them, stick on them, or hook up to them.

End-of-the-year issues of computing magazines are full of all sorts of awards and huzzahs for the Big Stuff. Fair enough, but I want to take a minute to call your attention to some wonderful Other Stuff that appeared this year—things that, given the bombast over clock doublers and active-matrix displays and Program Manager vs. Workplace Shell, you may have overlooked.

NEC's new InterSect CDR-74 CD-ROM drive is a good example. By doubling the spin speed of the CD—a feat that demanded some very sophisticated circuitry to handle the flow of data coming off that disk—NEC managed to shorten access times substantially. Anyone who works regularly with a CD-ROM drive—a couple million of us—knows that access times are still too slow. NEC took a big though quiet step this year to improve the state of the art.

Speaking of CD-ROMs, Trantor Systems did it again this year. Last year, Trantor made an industry standard of its invaluable MiniSCSI unit: a tiny, flat box that plugs into the parallel port of almost any recent PC and allows users to add such SCSI devices as CD-ROMs to those PCs, while passing through the printer connection and function. This year, the company outdid itself with a new MiniSCSI-in-a-cable product. The MiniSCSI Plus is even more elegant than its predecessor and almost twice as fast.

Speaking of SCSI, this year's pact between Adaptec and Corel promises some long-overdue sanity for PC users adding SCSI daisy chains to their PCs. Adaptec made the best SCSI interface cards, Corel the best SCSI software drivers. Under the new liaison, Corel has dropped its line of SCSI hardware, while Adaptec focuses on its strengths in hardware. We can look for combined Adaptec/Corel SCSI interface kits soon.

Microtek's amazingly inexpensive and amazingly good ScanMaker II turned the scanner market upside down. Now you can have 24-bit color for the same price as gray-scale scanning. Sub-$1,000 street prices for 24-bit color scanners are the last step toward making desktop scanners a commonplace, not an oddity, in many offices.

In printers, we saw two important developments: the arrival of the 600- by 600-dpi era in desktop lasers and the validation of the 11- by 17-inch laser printer as a business tool.

Hewlett-Packard's LaserJet 4 delivered nearly everything you'd want in a small, quiet, reasonably fast desktop laser—including true 600- by 600-dpi resolution. Several other vendors introduced 600-by-600 designs late in the year—or are racing them to market right now. The time of the 300- by 300-dpi printer has clearly passed, except for very low-end machines. (Sadly, Kyocera's innovative new Ecosys a-Si laser, a 300-by-300 model, is doomed because the company didn't understand how fast 600-by-600 would become the new standard.)

Let's hear it for the innovations that made computing a little faster, a little easier, and a little more fun this year.

QMS pioneered the fast 11- by 17-inch laser-printer market two years ago with its excellent QMS PS-2200 series. But the 2200s cost $10,000 to $12,000. This year QMS, DataProducts, Compaq, and others introduced fast new 11-by-17s at half that price. By quickly claiming market share both as fast 8.5- by 11-inch network printers and as occasional 11- by 17-inch-output ma-

Illustration by Mark Matcho

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Blackouts, brownouts, sags... Your data and hardware are vulnerable to problems that surge suppressors and power directors are just not equipped to handle.

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- 230V models available

	Model	Application	List	New List
	Back-UPS 250	LAN nodes, 386SX, 286, internet hardware, POS	$149	$139
	Back-UPS 400	Desktop 386, 486 systems, 286 servers	$249	$229
	Back-UPS 450	Tower 386, 486 systems, servers	$299	$279
	Back-UPS 600	Heavily configured systems, CAD/CAM workstations	$349	$319
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Jim Seymour

chines, they'll move our expectations for print speed and quality—as well as paper size—up a notch next year.

New 11- by 17-inch laser printers were only one group of products worthy of an award as a class. So were data/fax modems operating at 14.4 kilobits per second. This is absolutely the standard now for datacomm, and buying on the 9.6-Kbps side of the ledger is a mistake.

I think portables with built-in trackballs were winners as a class, too. So far, IBM and Compaq have the best designs, but we'll see lots more activity in this category over the next few months.

I'll concede that the Gateway 2000 HandBook is certainly a computer, but since it's not nearly in the class of the high-flying desktop and portable mega-machines that dazzled us this year, I call it Other Stuff. As I said last issue, it's an intriguing option for those seeking a compact traveling machine of modest but useful power.

The more I use the HandBook, the more I like it, and the more I see it as the first important design in a new class of computers. You won't confuse the HandBook with a "real" portable PC, I assure you—if by a "real" machine you mean one on which you'll be happy running your usual desktop applications. But I'm sure you also won't dismiss the HandBook as a toy, as you will so many palmtops coming to market.

Because it's not a viable Windows machine in its present form—and, probably, not in any revisions we're likely to see over the next few months—the HandBook isn't going to replace your desktop PC. But it sure is handy for checking e-mail, writing notes, and doing other similar chores.

That ability to stay in touch through e-mail (by dialing in to your office LAN and through third-party services such as MCI Mail) and the ability to send PC-generated faxes when you're traveling are so important that I think the combination of a HandBook and a tiny external data/fax modem is going to prove to be an important business tool. Maybe even a Personal Digital Assistant for the Rest of Us.

Finally, I can't resist pointing out a great 1992 Other Stuff item: Brady Books' new title *Jim Seymour's On the Road*. It's an indispensable compendium of tips and tricks for anyone who travels with a PC.

The Other Stuff in the software realm this year was also first-rate and worthy of a second look. More on the soft side next issue. ☐

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MICROSOFT WINDOWS READY-TO-RUN

We also streamline your application parameter files by removing unnecessary drivers and filters. And all NEC Select Solutions include the Visual Basic™ Library, allowing you to run any Microsoft Visual Basic program.

*Based on an approximation of industry average system prices and the cost of system set up. ** On site service may not be available in certain remote areas. NEC® and PowerMate® are registered trademarks, and Select Solution™, FG™, Image™, ImageSync™, and Express™ are trademarks of NEC Corporation and its affiliates. All other product, brand, trade names, registered trademarks, or logos used in this publication are property of the respective trademark owners.

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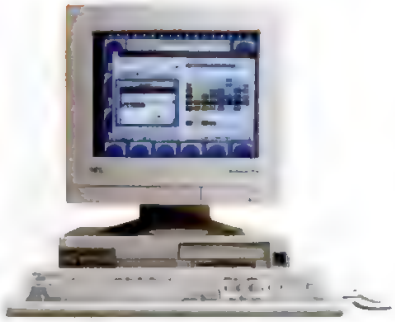

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CIRCLE 084 ON READER SERVICE CARD

William F. Zachmann

Parting Predictions

Since this is my last column for *PC Magazine,* I'd like to leave you with some broad predictions for the computer industry for the rest of the 1990s, instead of making my traditional 13 predictions for the coming year.

1993 to 1995: A tough couple of years. The next few years will be difficult ones for the computer industry. We're at the upper end of the S curve of growth in the use of personal computers as individual productivity tools. Nothing else is ready to take the PC's place yet.

The result will be a severe shakeout and consolidation among both hardware and software vendors. We're likely to see fewer and larger vendors in two years than we see now. In the short term, prices will continue to decline. By mid to late 1994, as the weaker vendors drop by the wayside, prices will firm up temporarily.

The primary engine of growth for the next two years will come under the rubric of downsizing, or client/server computing. PCs and other micro systems will be used to build industrial-strength systems of the sort that we once put only on mainframes and minicomputers.

Unfortunately, micro systems are not quite ready to take on the really big jobs that industrial-strength applications require. For this reason, computer users will remain confused and uncertain, and the industry's growth will be shaky.

Worse, a fair number of organizations have bought into the concept of downsizing with the ignorant zeal of the primitive tribespeople who heard of the virtues of electricity and then rushed to stick their fingers into the nearest available light socket to obtain its benefits. Our contemporary primitives, eager to throw the baby—their existing mainframe and minicomputer systems—out with the bath water, are destined to undergo an equally shocking experience.

1995: Consolidation and transition. By mid-decade, things ought to settle down nicely. Truly robust micro-based hardware and software platforms that can reliably support industrial-strength systems will be firmly in place. Competition among wannabe standards will lead to clear winners (and losers) and a consolidation around them.

My best guess at this point is that IBM and Apple together, rather than Microsoft, will have been most successful in defining a standards-based software environment by then. Growing success for OS/2 and the Macintosh and competitive losses for Microsoft and Windows over the next two years will pave the way to that outcome by the mid-1990s.

1996 to 2000: We get to the really good stuff! The best part of the decade will be its last half. That's when the real potential of modern micro-based digital information technology will find its own métier.

Despite all the hype about multimedia and other advanced technologies already in the air, none of that stuff will really amount to much before the middle of the decade. Sure, multimedia will create a nice niche before then, but it won't reach the mainstream for several more years.

Why? Because the processing power, storage, and communications bandwidth required to make the promise of multimedia a reality won't be affordable on a sufficiently wide scale until then. By the second half of the decade, though, technological advances will put sufficiently powerful hardware and software into the hands of consumers. Computers will rival television for entertainment and the best universities for education.

These advances will amount to the information-age equivalent of nuclear fission and fusion in physics and will create an entirely new market for information technology. I can hardly wait! How about you? □

In our departing columnist's crystal ball: a bleak immediate future, but promise of healthy years ahead.

Illustration by Mark Matcho

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and rearrange the fields on your screen in any layout you like. You can assign colors, typefaces, type sizes and typestyles. All by (you guessed it) simply pointing and clicking your mouse.

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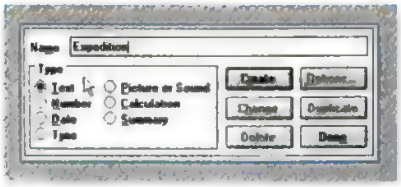
And unlike most databases, the way you see a FileMaker Pro file on the screen is an exact preview of what you'll see when



Defining fields is as easy as deciding what kind of information you want them to contain, giving them a name and then simply clicking a mouse.

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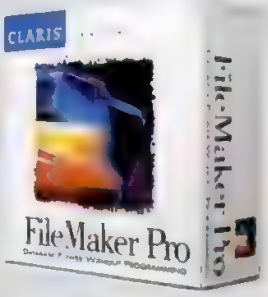

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CIRCLE 178 ON READER SERVICE CARD

THE 9th ANNUAL TECHNICAL

BY MICHAEL J. MILLER

Advances in personal computing are not usually due to single, amazing breakthroughs. Instead, they usually stem from many smaller, incremental improvements. In those all too famous words of Thomas Edison's, "Genius is one percent inspiration and ninety-nine percent perspiration." The same could be said for technical excellence.

In a year highlighted by increasing price competition, smaller computers, and bigger-than-ever software packages, the pace of technical innovation continues to be as astounding as ever. Over the course of this past year, we looked at breakthroughs on all levels, big and small, in hundreds of products.

Some will help productivity by making it easy for users to work in groups. These advances may mark a nostalgic end to the completely autonomous personal-computing era, but they will also open up new ways of sharing vast amounts of data.

Some of the products will bring multimedia to PCs, giving users the ability to store or manipulate large amounts of graphic and sound data. Others will make it easier than ever for users to take their computers and run—wherever their portables and businesses may take them.

And even others will help make our planet

AWARDS *for* EXCELLENCE

These annual awards acknowledge and honor those individuals whose creativity and energy have driven this industry.

a better place by saving on various natural resources.

As usual, for our Ninth Annual Awards for Technical Excellence, a panel of PC Labs staff and *PC Magazine* editors and contributors spent countless hours debating the merits of dozens of worthy contenders before settling on the winners and finalists. In many areas, such as applications software, graphics software, printers, and portable computers, there were many deserving products, and narrowing the field was a rather arduous process. All of the advances honored here have been examined by our reviewers and tested in PC Magazine Labs, revealing—in all cases—a surprising amount of technical achievement.

Since 1984, the Awards for Technical Excellence have been unique to the industry in highlighting breakthroughs in technology, not merely focusing on market share or personal favorites. The awards acknowledge and honor the work of the engineers, programmers, and business leaders whose creativity and energy have driven—and continue to drive—this industry.

To be eligible for this year's awards, products had to ship during the period from October 1, 1991, to October 1, 1992. The awards were presented at Fall Comdex '92, the computer industry's largest trade show.

Photograph by Michel Delsol

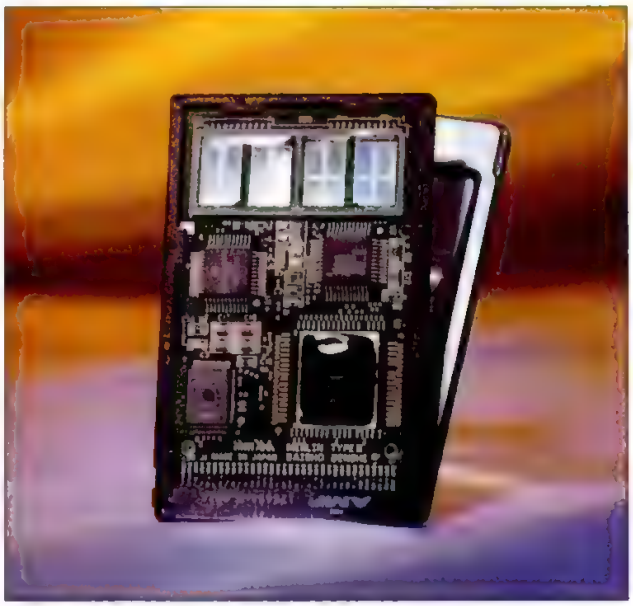
HARDWARE STANDARDS

Good standards spare us from misadventure with hardware compatibility. But the problem with standards is that they usually become standards just as the next technology is beginning to emerge. This year's honorees rose to the forefront and stayed there long enough to garner the favor of the manufacturers.

WINNER

PCMCIA, Release 2.0

John Reimer and PCMCIA



PCMCIA, created by the Personal Computer Memory Card International Association, is quickly becoming the standard for notebook computer expansion slots, and Release 2.0 of the maturing specification makes notebooks more useful. The specification describes a credit card–size, 68-pin add-in card, available in different thicknesses—the most popular being the 5-millimeter Type II. Its nearly indestructible casing houses memory or flash memory.

PCMCIA 2.0 includes clearer definition of memory cards. This version of the standard also adds a second interface for I/O cards and dual-battery-voltage capacity. Release 2.0 allows for plug-in cards that are thicker than the earlier PCMCIA cards and capable of executing in place or running without using system RAM. They work in all machines with PCMCIA slots—from hand-held personal assistants to subnotebooks to full-feature portable computers.

We're already seeing a variety of PCMCIA cards used for both storage and I/O: memory cards, applications cards, 2,400-bps modems, fax modems, and network connections. One problem is that the PCMCIA I/O cards often require clunky and unwieldy external connections for converting from PCMCIA to RJ-11, but that may be the price we pay for a worldwide standard.

▶*Personal Computer Memory Card International Association, 10308 E. Duane Ave., Sunnyvale, CA 94086; 408-720-0107.*

FINALIST

VESA VL-Bus Standard 1.0

Tom Ryan and VESA

This will be known as the year we jumped off the bus—the expansion bus. By removing video cards from the 8-MHz expansion bus and putting the video directly on the motherboard, vendors think they can eliminate bus throughput problems and speed the video on faster PC systems.

As video goes, so follow other subsystems; a similar approach to populating the motherboard may soon be tried with mass storage, multimedia, LAN adapters, and other devices. But first, peripherals supporting local-bus video must become widely available, and that means we need a standard. The first local implementations were proprietary designs. But the VESA committee's specification, the VL-Bus, would ensure compatibility with designs from multiple vendors, bringing arbitration and bus mastering to local-bus designs while letting systems continue supporting the standard ISA or EISA slots. The VL-Bus is already feeling competition from Intel's PCI local-bus implementation, but for now, it remains the closest thing to a local-bus standard.

▶*Video Electronics Standards Association, 2150 N. 1st St., #360, San Jose, CA 95131; 408-435-0333.*

Photographs by Thom O'Connor

Operating Systems and Software Standards

Software standards rescue us from the Tower of Babel syndrome. They offer clever and innovative ways for us to exist with our past, present, and future technologies. Software standards let us speak different tongues but still communicate.

WINNER

OS/2, Version 2.0

Lee Reiswig and the OS/2 2.0 Team

While Microsoft continues to beat the "Windows Everywhere" drum, IBM has taken OS/2 and created an alternative to DOS and Windows, with some surprising technical advances. The long-awaited system is a full 32-bit graphical operating system that is protected, multithreaded, multitasking, and preemptive. With OS/2, multitasked applications can't stomp on each other's memory space. OS/2's ability to run 32-bit applications also makes it potentially faster than existing 16-bit systems because bigger chunks of data can be moved around memory at one time. The new OS/2 user interface, the Workplace Shell, is a more document-oriented, object-oriented approach to a graphical user interface. Each interface element is an "object," and object properties such as color and settings are accessed in menu form by clicking on the object with the right mouse button. A new Seamless Windows feature lets Windows applications run alongside DOS and OS/2 applications and allows OS/2 and Windows applications to share information via the Clipboard or Dynamic Data Exchange. As 32-bit applications begin to appear, the true benefits of OS/2 will become clear.

▶*IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-342-6672.*

FINALISTS

TrueType in Microsoft Windows, Version 3.1

Dennis Adler, Eliyezer Cohen, David Weise, and the TrueType Team

What do users want from their fonts? They want their screen fonts and printer fonts to match; they want good-looking fonts in all sizes, and they want a high degree of integration between their fonts and their operating systems. TrueType, built into Microsoft Windows 3.1, does it all.

Adobe's Type 1 technology remains the standard in most typesetting applications, but TrueType—developed by Apple Computer and Microsoft—brings outline font technology to the masses with its collection of basic TrueType fonts.

The root of TrueType's technical excellence is its hinting technology. Unlike most font technologies, which rely on specific hinting for each font and depend heavily on rasterizer intelligence, TrueType has a generalized language for handling multiple forms of hinting. "Smart hinting" makes fonts appear properly formed at all sizes. TrueType also works with existing hinting technologies and adds new ones, such as the ability to force consistent stroke weights.

▶*Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

Twain

Kevin Bier, James Graham, Morris "Mojo" Jones, Jim McCarthy, Tom Napoli, Dominique Pitteloud, Eric Robinson, Jim Zamiska

What Windows printer drivers do for graphics output, Twain does for graphics input. Applications developers can write their applications for the Twain API; while vendors of scanners and other input devices can create their own device drivers, so applications can more easily take advantage of unique features. Aldus, Caere, Kodak, Hewlett-Packard, and Logitech were among the first to spearhead the standard. Most standards are controversial, but this one is so straightforward it's now supported by most major vendors of graphics hardware and software.

▶*Twain Working Group, Attn: Kathy Jooss, Hewlett-Packard Co., 700 71st Ave., Greeley, CO 80634; 303-350-4755.*

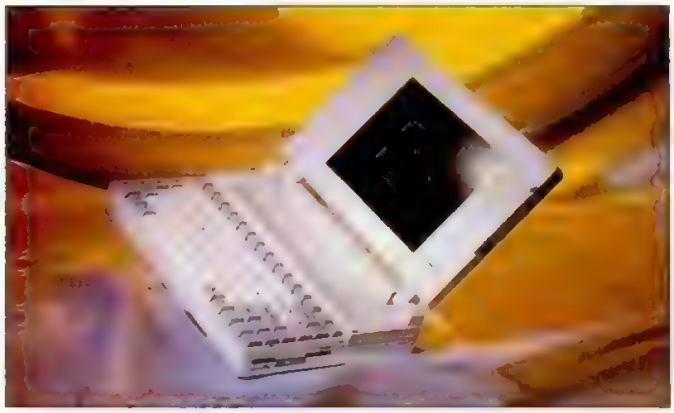
PORTABLES

Laptops continue to be the real hotbed of PC activity, in terms of both unit sales and technical innovations. Smaller, lighter, longer-powered, better-looking, and better integrated than ever, these machines are not only the business executive's computer-in-a-briefcase, they are well on their way to conquering the desktop.

WINNER

Toshiba T4400SXC

Steve Andler, Keith Comer, Hiroyuki Furukawa, Hidehito Murato, Manfred Sokat, Hiroki Zenda



This is the system for anyone who wants it all. The Toshiba T4400SXC was not the first color notebook on the market, but its luxurious color sets a standard of excellence. Toshiba combines a brilliant 256-color TFT (Thin Film Transistor) screen with a 25-MHz 486/SX CPU, lots of memory, and a hefty 120MB hard disk. The much-acclaimed keyboard and the surprisingly long-lasting battery both are tucked into a handsome, lightweight portable package.

Not resting on laurels, Toshiba has already replaced this current design with a larger-screened T4400C, available in both SX and DX flavors. When you consider that you can purchase a fully rigged Toshiba docking station for your T4400SXC, the machine poses a formidable challenge to a desktop system as well.

▶*Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445.*

FINALISTS

Dell 320SLi

Jim Garrett, Mark Kimbro (of Design Edge), David Lunsford, Chris Okonsky, Greg Stewart

When you think small, think of the Dell 320SLi. The smallest 386 yet, the 320SLi weighs only 3.6 pounds and measures just 1.3 by 11 by 7.8 inches (HWD). In this diminutive casing sits a powerful 20-MHz 386SL and a PCMCIA Type II connection. The 320SLi comes standard with an internal 60MB hard disk; 120MB hard disks are also available. Dell took off the pounds by removing the backlighting, equipping the machine with a reflective VGA display, and removing the floppy disk drive. The machine comes with the smallest external floppy disk drive around. It's all muscle, no fat.

▶*Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355.*

Z-Note 325Lc Model 120

Mark Foster and the Godzilla Engineering Team

Zenith Data Systems' Z-Note series keeps you connected—and with considerably less effort than other notebook PCs.

The series offers several innovations, including built-in local-area networking via an integrated Ethernet port. The Z-Notes also come with Microsoft LAN Manager, NetWare, and VINES client shells preinstalled for simplified connectivity. Additionally, they are among the first notebooks to ship with Windows for Workgroups.

There is an optional external port replicator as well, so you can hook into an external monitor, mouse, keyboard, or printer more easily than ever before.

Moreover, the Z-Note 325Lc Model 120 is one of the smallest active-matrix color machines with a decent battery life that we've seen.

▶*Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-446-6372.*

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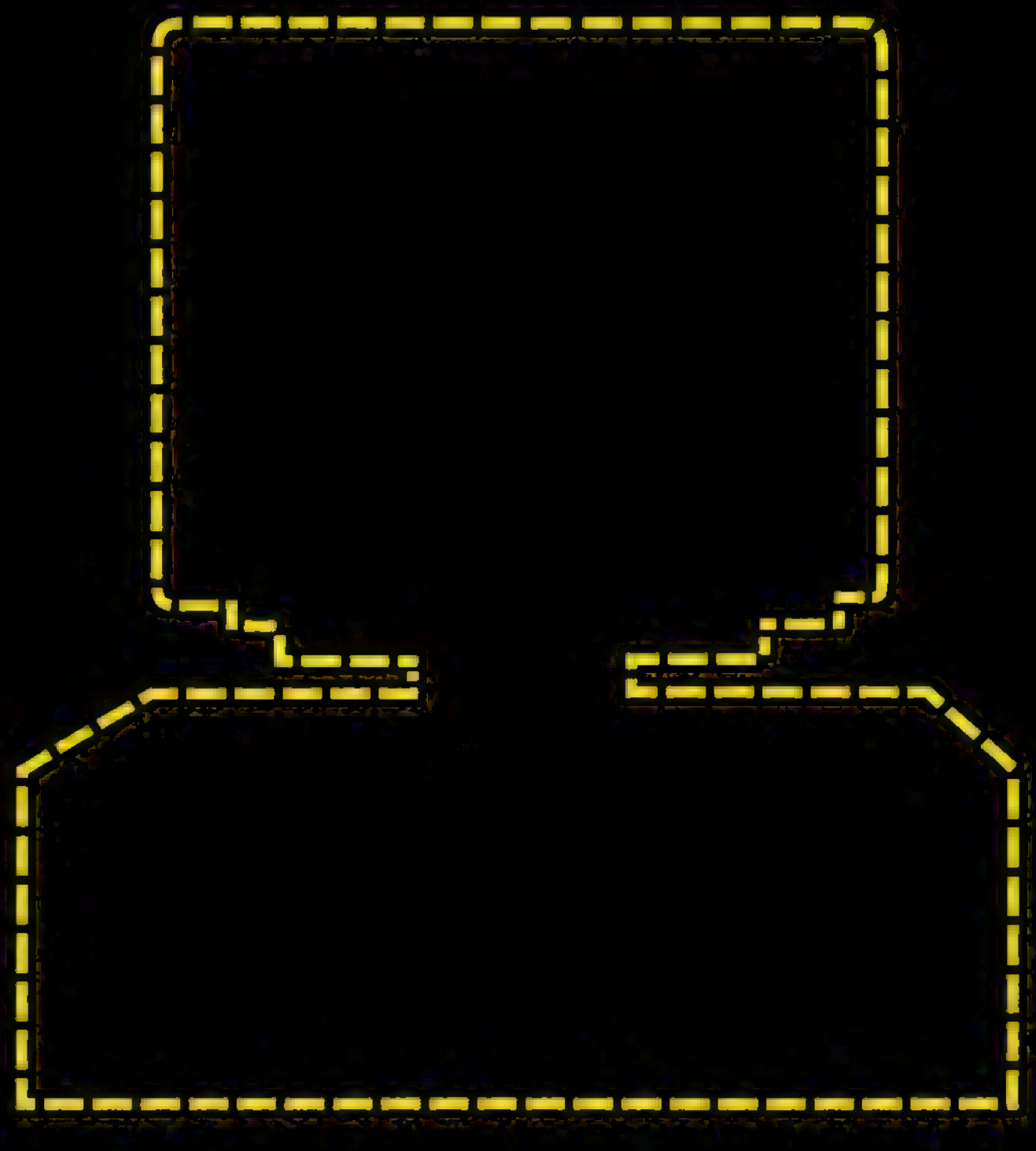

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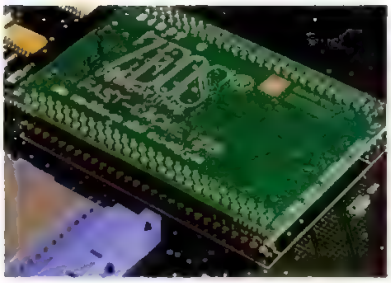

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#1 IN EXPANDABILITY & RELIABILITY!

Of course power and expandability are ZEOS hallmarks. In their haste to cut features and to cut prices it would seem the others have forgotten about your future. That's why ZEOS has things like *eight* expansion slots, *high-capacity* power supplies and *seven* drive bays all in our standard SpaceSaver desktop cases. We care about you and the long-term ownership of your new computer. We invite comparison. The more you look, the more obvious your ZEOS advantages become.

Like the two cooling fans you'll find in every ZEOS system. While ZEOS systems run cooler than most with *one* fan we still give you *two whisper-quiet cooling fans.* The cooler your system runs the longer it will last. We also include a *built-in surge suppressor* in every system. It's all part of ZEOS' built-in Award Winning reliability. Of course every ZEOS system carries the Underwriters Laboratories listing as well. These are extra features the others *can't* or *won't* offer you. From ZEOS, they're yours. No additional charge.

FREE LOTUS SOFTWARE TOO!

And don't forget, when you purchase any new ZEOS Windows based system, you will also receive your choice of two: *Lotus 1-2-3 for Windows, Ami Pro,* and *Freelance Graphics.* You're going to love it. The software alone carries a suggested retail price of over $1,000 and we're giving it to you *absolutely free.* Now that's ZEOS Value.

24-HOUR-A-DAY SUPPORT. AND MORE!

Remember too, ZEOS provides you with our top-rated 24-Hour-a-Day Toll-Free Technical Support. *Plus* your new ZEOS system is covered by our 30-Day Money-Back Guarantee, One Full Year Limited Warranty, and our Express Parts Replacement Policy.

MORE FEATURES. MORE PERFORMANCE. LOWER PRICES.

There is no question. While everyone else is cutting prices by giving you less, ZEOS is cutting prices and giving you more. Whether you choose the 486SX-25, the amazing 486DX2-66 or anything in between—*ZEOS gives you the most for your money.* So go ahead and give us a call.

CALL NOW TOLL FREE.

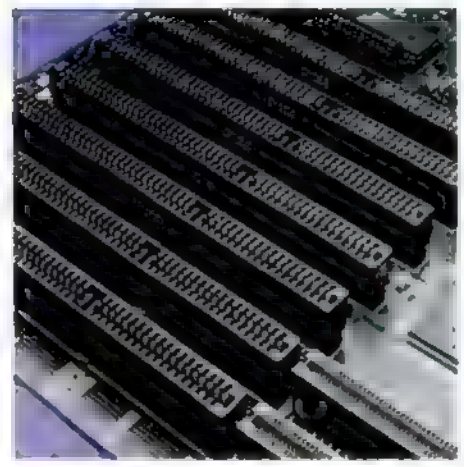
800-423-5891

Ordering your new ZEOS upgradable system is easy. Simply pick up the phone and give us a call. A friendly and knowledgeable ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS system. *Why not give us a call right now!*

Purchase orders from Fortune 1000 companies, governments and institutions subject to approval. Leasing programs are available. All prices and specifications are subject to change without notice. Please call to confirm pricing, specifications and warranty details. The following are trademarks of their respective companies: ZEOS (ZEOS International, Ltd.). © 1992, ZEOS International, Ltd., 530 5th Avenue, N.W., St. Paul, MN 55112 USA. ZEOS is a publicly traded company (NASDAQ symbol: ZEOS). UPGR8P-PCM-9212B

ZEOS systems feature award winning reliability and support. Nine times PC Magazine's *Editors' Choice.*

The on board SCSI option lets you add SCSI I or II devices anytime. SCSI hard drives, opticals and more are easy to add.



Eight expansion slots provide you with plenty of room to add to your system in the future.

Pick Your Power!

ZEOS Complete System Package #1

- Your choice of CPU with upgrade options. Our Zero Insertion Force (ZIF) upgrade socket makes it easy.
- 2MB of high-speed RAM expandable to 64MB on board.
- 85MB high-speed IDE hard drive with built-in cache.
- 1.2MB or 1.44MB Teac® FDD.
- ZEOS 14" Hi-Res mono VGA monitor with 1MB high-speed VESA Local Bus card.
- Eight expansion slots including two VESA local bus slots.
- Two serial and one parallel port.
- Shadow RAM/ EMS support.
- Optional SCSI port (plug-in chip) for SCSI I & II devices including hard drives, tape drives, optical disks and more.
- Upgradable high-speed cache options of 128K and 256K.
- Flash BIOS for easy BIOS upgrades via disk or modem.
- High-capacity power supply with built-in surge suppression.
- Rugged ZEOS SpaceSaver case with seven drive bays and two cooling fans for added reliability.
- ZEOS RS/101 key tactile/click keyboard, double injection key caps with Alps keyswitches.
- Microsoft DOS Version 5.0.
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support, 30-Day Money-Back Guarantee, Customer Satisfaction Package.

Incredible ZEOS Package #2

We take package #1 and add more memory, a bigger drive, both floppies plus Windows, a MS Mouse *and* your choice of two Lotus Windows software applications, free!

- Your choice of upgradable CPU.
- 4MB of RAM expandable to a system total of 64MB.
- Our 130MB high-speed IDE hard drive with built-in cache.

PACKAGES 2, 3 & 4 INCLUDE LOTUS BUNDLE!

	Pkg. #1	Pkg. #2	Pkg. #3	Pkg. #4
486SX-25	$1395	$1995	$2295	$2895
486SX-33	$1595	$2195	$2495	$3095
486DX-33	$1795	$2395	$2695	$3295
486DX2-50	$1995	$2595	$2895	$3495
486DX2-66	$2195	$2795	$3095	$3695

Add $149 for 128K or $298 for 256K cache.

- Both 1.2MB and 1.44MB Teac® floppy drives.
- ZEOS 14" Hi-Res 1024 x 768 non-interlaced VGA color monitor with 1MB high-speed VESA Local Bus card.
- Microsoft DOS, Windows and a genuine MS Mouse, your choice of two out of three Lotus applications for Windows: Lotus 1-2-3 for Windows, Ami Pro, and Freelance Graphics.

Incredible ZEOS Package #3

With Package #3 we add even more memory, a larger drive *and* even more savings.

- Pick the CPU power you want.
- 8MB of RAM expandable to 64.
- A full 245MB high-speed IDE hard drive with built-in cache.
- Both 1.2 and 1.44 Teacs.
- ZEOS 14" Hi-Res 1024 x 768 non-interlaced VGA color monitor with 1MB high-speed VESA Local Bus card.
- Microsoft DOS, Windows and a genuine MS Mouse, your choice of two out of three Lotus applications for Windows: Lotus 1-2-3 for Windows, Ami Pro, and Freelance Graphics.

The Ultimate! ZEOS Package #4

There's not another system like it anywhere! Memory goes to 16MB, your drive up to 340 Megabytes. No-body can touch it. This baby's hot!

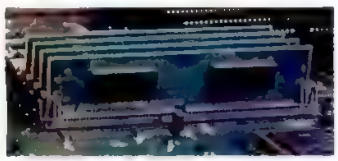
- Go with whichever CPU you choose. We recommend at least the 50 if not the 66MHz with all this power!
- 16 full megabytes of blazing RAM.
- Our screaming 340MB IDE HDD.
- Both Teac® floppies.
- ZEOS 14" Hi-Res 1024 x 768 non-interlaced VGA color monitor with 1MB high-speed VESA Local Bus card.
- Microsoft DOS, Windows and a genuine MS Mouse, your choice of two out of three Lotus applications for Windows: Lotus 1-2-3 for Windows, Ami Pro, and Freelance Graphics.

ORDER NOW TOLL FREE

800-423-5891

Fax Orders: 612-633-1325
Open 24 Hours a Day
365 Days a Year!

Fast 36-bit memory SIMMS provide you with optimum flexibility supporting up to 64 megabytes on the motherboard.



ZEOS gives you two local bus slots designed to the VESA standard, capable of local bus mastering.

ZEOS systems carry the most demanding safety listings including the Underwriters Laboratories (UL) listing on the entire system.

Get 66MHz Power. Now! Only $2195!

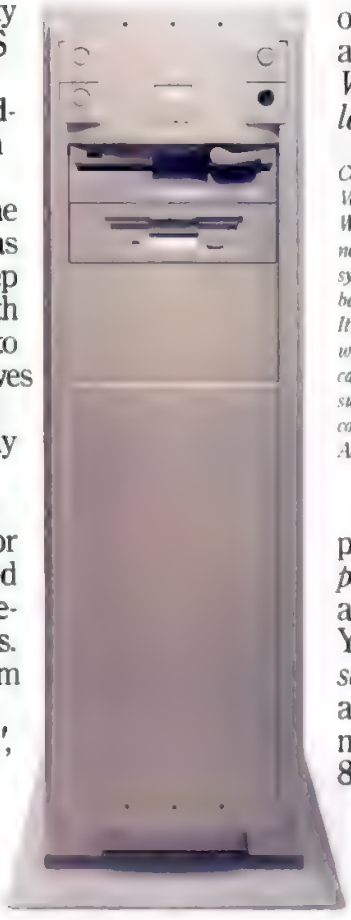
It starts with the desire to own one of the fastest PCs in the world. It's a thirst to have the very best money can buy. But there is always the question of money. How much for how much?

MORE POWER. FOR LESS MONEY.

From ZEOS you get more for less, *absolutely.* If power, capacity, speed and upgradability are what you're after, the ZEOS 66MHz '486 is the one for you. We've put together some incredible new money-saving system packages for you. Take a look.

Right now you can get into the ZEOS '486 66MHz for as little as $2195. And power users can step right up to even more savings. With *standard packages* featuring up to 16 megabytes of memory and drives to 340 megabytes. Plus, ZEOS offers more options than probably anyone else in the business.

You can use any of our package platforms as launch points for more power than has ever existed in a PC before. *Whatever* your requirements are, throw them at us. You'll come away with your dream system, loaded for bear. Drives by the gigabyte, monitors to 21", power servers like no others.



Consider the Vertical Option. We can build your new upgradable system in our eight-bay vertical case. It comes complete with our high-capacity power supply and two cooling fans. Add only $95.

ZEOS EXTRAS FOR YOU. NO EXTRA CHARGE.

In all the excitement, don't forget that you're getting one of the most advanced and fully featured PCs in the world. The incredible new ZEOS system board is just for starters.

Because at no additional charge you're also getting extras like your choice of two of three great Windows applications: *Lotus 1-2-3 for Windows, Ami Pro* and *Freelance Graphics* with any ZEOS Windows system. And every system comes standard with built-in surge suppression, two cooling fans, our rugged seven-bay case, *and* the best 24-Hour Support package in the industry.

So for incredible '486 66MHz power, complete compatibility *plus* award-winning reliability and support—give us a call. You're going to be *very satisfied.* And that's a guarantee! Call now toll free: 800-423-5891.

intel inside

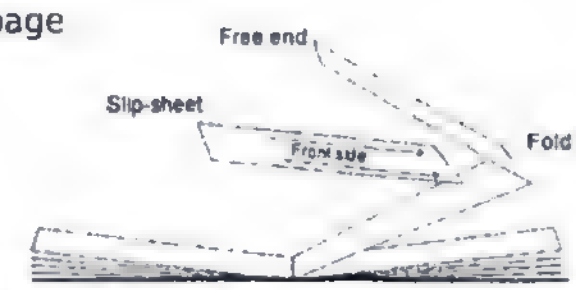
Folded edge of the page

Foldout slip-sheet

GbsSlipSheet-001

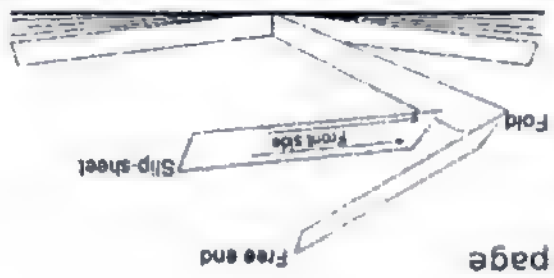
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

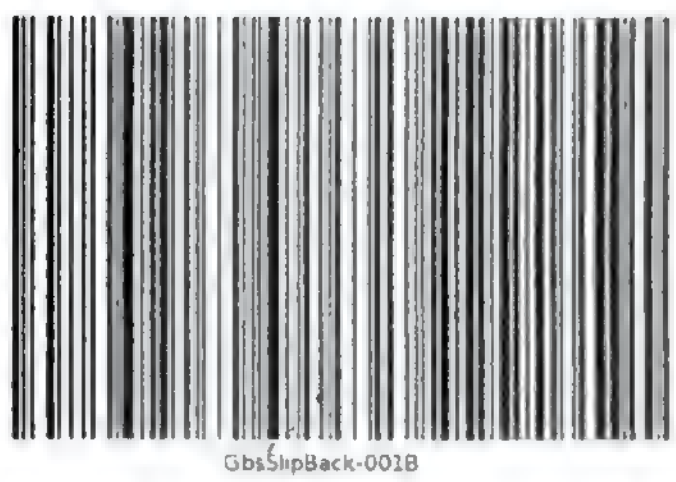


Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



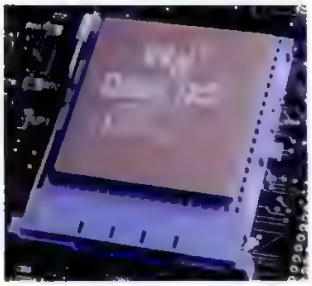
Inverted Back



Back

1. Follow instructions on the other side

1. Follow instructions on the other side



Pick your power! 486SX-25 thru the 486DX2-66. And upgrading is easy with our Zero Insertion Force (ZIF) socket. Note the extra row of pins for the future OverDrive™ CPU based on Intel's P5 technology.

When you buy any ZEOS Windows system you can choose 2 of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro and Freelance Graphics for Windows!

New ZEOS® PCs!

You simply get more. For less. When everyone else started cutting prices by giving less, ZEOS had a better idea—Use the very latest technology to design an entirely new line of high performance upgradables that allow us to *charge less while giving more.* You're going to love it!

Because now these new ZEOS systems give you more of everything you're looking for. Speed, reliability, compatibility, 24-Hour Support and more. Plus, the ultimate in upgradability! No one else has anything like it, at any price. *You'll be amazed.*

Your new ZEOS upgradable system leaves everybody else in the dust. Just run the benchmarks and the others turn green with envy. But we don't just stop with PCs that are among the fastest in the world.

By using the very latest in 486 chip set technology we have been able to incorporate more new features than ever before.

TWO VESA STANDARD LOCAL BUS SLOTS.

While the others are talking about local bus, often creating their own non-standard solutions, ZEOS gives you a VESA future. As a working member of the VESA Standards Committee, ZEOS has incorporated *two* slots conforming to the recently established VESA standard.

More Features. Greater Pe

ZEOS. THE UPGRADABLE EXPERTS.

Nobody knows upgradability better than ZEOS. After all, ZEOS was one of the first to introduce truly high performance upgradable PCs. Now using the latest in high integration technology we've made a good thing even better, right up to the 486DX2-66 and beyond.

How far beyond?

Try the future OverDrive™ processor based on Intel's P5 technology! Start today with the '486 CPU of your choice. Select between the 486SX-25 or 33, the 486DX-33, the 486DX2-50 or the 486-DX2-66. Then, in 1993, you'll be able to add the new super processor (you'll note the extra row of pins around each side of your CPU upgrade socket, that's what they're for). Maximum power today *and* tomorrow. When we talk power we're talking speed.

Lower Prices.

What does this mean to you?

Unparalleled VESA local bus performance! We've taken one of your two VESA local bus slots (which can also be used for standard 16-bit cards if you wish) and added a *screaming* local bus video card. Windows has never moved so fast! And with our bus mastering capability, a second local bus card can be added in the future as well. ZEOS gives you more performance options than anyone else. *Take a closer look!*

PEAK PERFORMANCE. A ZEOS STANDARD.

With ZEOS, performance enhancements are standard. If you have a technical bent you'll love reading about them. If you're a typical user, just tell your friends your new ZEOS system has these things. They'll be impressed. Like what?

Tell them about the upgradability and VESA standard local bus mastering slots. Mention your new system has FLASH BIOS for easy BIOS upgrades via disk or modem. Also mention your true 80486 VLSI chip set with burst mode memory support, talk

Computers Now!℠

We Can Ship Your Order Today!

RIGHT NOW. GUARANTEED!*

In a hurry for your new system? We can ship your choice of these hot new ZEOS '486s *today!* They're our most popular configurations.

Here's how it works. We have these incredible ZEOS '486 color VGA systems pre-built and ready to ship. While supplies last, we will ship any of these systems to you *the day you order* subject to these conditions:

1. Your order must be received by 1PM Central Time M-F.
2. Credit Cards are subject to authorization.
3. Orders must be for ZEOS '486 systems configured as shown here. Any other systems or upgrades are custom-built and will take slightly longer.

***OUR GUARANTEE TO YOU:**

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship at *our expense* as soon as it is ready.

This offer is good only as long as these pre-built systems remain in stock; please give us a call to verify availability. This offer does not apply to other ZEOS systems or custom configurations.

IMMEDIATE SHIPMENT IS ONLY PART OF THE STORY.

These are not just any computer systems. They're the high-performance, high-quality ZEOS systems. Packing all the ZEOS value that has won *PC Magazine Editors' Choice—nine times!*

So why not give us a call right now. If we hear from you by 1:00 this afternoon, we'll get your new system on the way to you today! Call now Toll Free, 800-423-5891.

Purchase orders from Fortune 1000 companies, governments and institutions subject to approval. Leasing programs available. All prices and specifications are subject to change without notice. Please call to confirm pricing, specifications and warranty details. The following are trademarks of their respective corporations: Microsoft MS-DOS and Windows are Microsoft Corporation. ZEOS computers, Now, SpaceSaver, SuperCase and Z-Card are ZEOS International Ltd. © 1992 ZEOS International Ltd. 7204 5th Avenue N.W., St. Paul, MN 55112 U.S.A. ZEOS is a public traded company, NASDAQ symbol: ZEOS. Lotus is a registered trademark of Lotus Development Corporation. Ami Pro is a trademark of Samna Corporation, a wholly owned subsidiary of Lotus Development Corporation. UPG/R&P PCM 9212B

486SX-25 $[illegible]
486DX-33C $[illegible]
486DX2-50C $[illegible]

- Upgradable CPU feature: our Zero Insertion Force (ZIF) upgrade socket makes it easy in the future.
- 486DX-33C and 486DX2-50C feature our 128K SRAM cache.
- 8MB of high-speed RAM.
- 245MB high-speed IDE hard drive with built-in cache.
- 1.2MB and 1.44MB 3.5" floppy drives.
- ZEOS 14" Hi-Res 1024x768 non-interlaced VGA color monitor with 1MB high-speed VESA standard Local Bus Video adaptor.
- Eight expansion slots including two VESA standard local bus slots.
- Two serial and one parallel port.
- Shadow RAM and EMS support.
- Flash ROM BIOS.
- High-capacity power supply with built-in surge suppression.
- Rugged ZEOS SpaceSaver case, seven bays, and two cooling fans for added reliability, expandability and component life.
- ZEOS RS/101-key keyboard.
- Microsoft DOS, Windows and a genuine MS Mouse; your choice of two out of three Lotus applications for Windows: Lotus 1-2-3 for Windows, Ami Pro and Freelance Graphics.
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support, 30-Day Money Back Guarantee and Customer Satisfaction Package.

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TDD Orders: 800-228-[illegible]
Outside U.S. and Canada: 612-633-6131
MasterCard, VISA, Am[illegible], Discover, Z-Card, COD and Leasing programs.
Open 24 Hours a Day, 365 Days a Year!

ZEOS

A. YOUR PERSONAL INFORMATION

Please complete all appropriate sections, *providing at least two years residence and employment history. THIS IS NOT A CREDIT AGREEMENT!* One will be sent to you upon authorization of an account. (This form must be signed to process your application.) All financed purchases are subject to credit approval. *If you have any credit questions, please call 800-421-8942 for assistance.* Thank you!

Name _____ Previous Address _____

Home Phone (____) _____ City _____ State _____ Zip _____

Soc. Sec. No. _____ Date of Birth ___ / ___ / ___ Employer _____ Since? (Mo./Yr.) _____

Address _____ Apt _____ Monthly Gross Salary $ _____ Daytime Bus. Phone (____) _____

City _____ State _____ Zip _____ Previous Employer _____ From _____ To _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____ Occupation _____

A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT.** Do not complete section C.**

** If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

NOTICE TO WISCONSIN APPLICANTS:
YOU MUST DISCLOSE YOUR MARITAL STATUS.
☐ married ☐ unmarried ☐ legally separated

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income $ _____ Source _____

Name & Address of Nearest Relative Not Living With You _____

_____

Relationship _____

B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE A

Checking Account ☐ Yes ☐ No
Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ___ / ___ / ___

Address _____ Apt. _____

City _____ State _____ Zip _____

Home Phone (____) _____ Date of Residence (Mo./Yr.) _____

Joint Applicant's Employer _____ Since? (Mo./Yr.) _____

Bus. Phone (____) _____ Monthly Gross Salary $ _____

CUSTOMER AUTHORIZATION

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature _____ Date _____

Joint Applicant's Signature _____ Date _____

FOR MARRIED WISCONSIN APPLICANTS: I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature _____ Date _____

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800-421-8942 or 612-635-0613 or write to ZEOS, Z-Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.

NY–A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH–The Ohio laws against discrimination require that all creditors make credit equally available to all creditworthy customers and that credit reporting agencies maintain separate credit histories on each individual upon request. The Ohio Civil Rights Commission administers compliance with this law.

*Financing not available in Alaska, Hawaii or outside the continental U.S.

ZCDJT-PCM-9212B

Z-CARD PRIORITY APPLICATION FAX NUMBER: 612-633-7507

Apply for your own Z·Card™ today!

Here's another great reason to buy a ZEOS system: the Z-Card™! The Z-Card works just like a MasterCard or VISA–so you can charge your ZEOS purchases and pay in easy monthly installments. And since no down payment is required, it makes buying your new ZEOS system easier than ever!

You can apply for your very own Z-Card and low, low monthly payments right now. Simply fill out this application and fax it to 612-633-7507. Or mail it to ZEOS International, Z-Card Processing Center, 530 5th Ave. NW, St. Paul, MN 55112. We'll contact you as soon as your credit line is established, usually within 24 hours of receipt. Apply today!

CIRCLE 115 ON READER SERVICE CARD

SYSTEMS

If you thought that desktop PCs had seen the end of innovation, think again. The winners in this category are rugged individualists that set the pace for things to come.

WINNER

Compaq Deskpro 66/M

Deskpro 66/M Team

Compaq's high-end desktops have always been models of superior performance, and the Compaq Deskpro 66/M fits right in. This model, one of the first speed-doubled DX2 computers available, adds a 66-MHz 486DX2 processor card into the modular EISA-based series, resulting in top performance. The processor sits alongside several new features Compaq has introduced into the M series this past year, including built-in Business Audio capabilities and the speedy QVision 1024/E graphics card.

This proprietary video subsystem, with 256-color 1,024-by-768 resolution, uses its own 32-bit graphics accelerator on a 32-bit EISA adapter—plus linear addressing with 1MB of video RAM—to speed up graphics processing without taxing the CPU as much as conventional accelerators do. The end result is in every respect one of the fastest machines we've seen to date.

▶*Compaq Computer Corp., Customer Support Center, P.O. Box 692000, Mail Drop 120208, Houston, TX 77269; 800-345-1518.*

FINALISTS

Compaq Systempro/XL

Systempro/XL Team

Compaq has always been known for its innovations in PC hardware, and the new Systempro/XL doesn't disappoint. This powerful multiprocessor-capable server features a unique TriFlex System Architecture, capable of arbitration between a 64-bit processor bus, the 128-bit memory bus, and the 32-bit EISA bus. In addition, the new server includes NetFlex—a 32-bit EISA controller that supports Ethernet and (with a snap-on daughter card) Token-Ring.

The server has a large array of server-management services built in, including automatic server recovery, an error log, and automatic revision tracking. The Systempro/XL offers a scalable solution to disk I/O, offering users a choice of controllers. Compaq, as usual, is delivering a machine that is clearly designed for the next generation in processor technology.

▶*Compaq Computer Corp., Customer Support Center, P.O. Box 692000, Mail Drop 120208, Houston, TX 77269; 800-345-1518.*

Gateway 4DX2-66V

Jim Collas and the Gateway 2000 Product Development Team

The first in a new line of machines from Gateway 2000, the 4DX2-66V shows real innovation with a host of high-powered components that have been combined into an inexpensive system—the ultimate price/performance combination.

The machine features two VL-Bus slots, including a top-flight integrated local-bus video system based on ATI's touted mach 32 68800 processor.

The 4DX2-66V is also one of the first machines to have local-bus IDE, which speeds hard disk performance. Gateway topped our reliability survey earlier this year, and this machine maintains Gateway's position as a value leader.

▶*Gateway 2000, 610 Gateway Dr., No. Sioux City, SD 57049; 800-523-2000.*

PRINTERS

At least for the time being, the PC printer is the voice of the PC. Whether it's more color, more pages per minute, better connections, or a newfound sense of social responsibility, these printers stand out in the chorus.

WINNER

Ecosys a-Si Printer FS-1500A

Yasuo Nishiguchi

It probably won't cut down on your paper consumption, but the Kyocera Ecosys a-Si Printer FS-1500A cuts down on most of the other consumables involved with printing.

In most laser printers, you have to replace both the toner cartridge and the drum on a regular basis. In the Ecosys a-Si the drum and photoconductor last the life of the printer. Kyocera Electronics is the first company to deliver a personal printer with an amorphous silicon drum (the a-Si in the name stands for amorphous silicon), previously found only in copiers. The drum uses a thin film deposition coating, which creates a surface that is more durable than the OPC (organic photoconductor) coating used in other laser printers.

The Ecosys is also rated at 300,000 pages—or more than 20 years of average use. You will have to refill its microfine ceramic toner formula every 5,000 pages. But new toner costs only $39, which translates to a low per-page cost of less than an eighth of a cent. This figure compares with the average two- to three-cent-per-page cost found with most laser printers.

▶*Kyocera Electronics Inc., 100 Randolph Rd., Somerset, NJ 08875; 800-621-6777.*

FINALISTS

Compaq Pagemarq Series

Pagemarq Team

Compaq chose to enter the printer market with a splash; its new Pagemarq line of 15- and 20-page-per-minute printers features some of the most flexible network printers we've ever seen. The RISC-based printers offer both Adobe PostScript Level 2 and Hewlett-Packard's PCL 5 printer languages, as well as Compaq's own Print Enhancement Technology and an 800- by 400-dot-per-inch PostScript resolution. Compaq's Pagemarq Series offers users just about anything they could want in a reasonably priced line of network printers.

▶*Compaq Computer Corp., Customer Support Center, P.O. Box 692000, Mail Drop 120208, Houston, TX 77269; 800-345-1518.*

Tektronix Phaser IISD

Jeff Clark, Brian Crosby, Todd Garcia, Bo Lewendal, Hem Mathur, Judd Sirotiak, Perry Wingfield

A professional's tool at an affordable price, the Tektronix Phaser IISD is an under-$10,000 printer that uses dye-sublimation technology to produce quality color output with continuous tones. The Tektronix Phaser IISD supports Adobe PostScript Level 2 and has its own Photofine resolution enhancement technology that raises it far above competitors for color text and makes it a top-notch graphics printer.

The powerful print engine, a 300-dpi Sharp/Tek 4684, is rated at 4.1 minutes per page for four-pass color. You'll be hard pressed to tell the difference between a photographic print or a full-color printout from the Tektronix Phaser IISD.

▶*Tektronix Inc., 26600 Southwest Pkwy., Wilsonville, OR 97070-1000; 800-835-6100, 503-682-7377.*

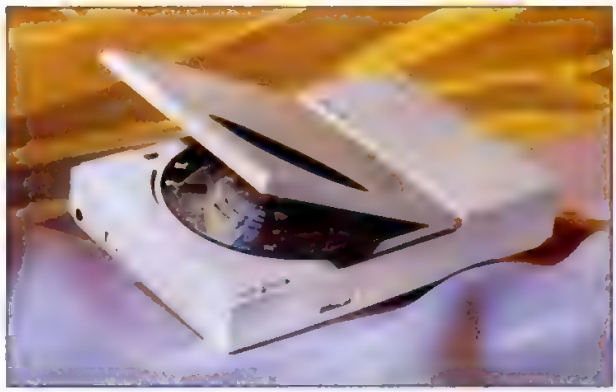
PERIPHERALS

The number of CD titles has more than doubled since last year; the players are now fast and affordable. With at least 600MB of storage space, the CD player provides a repository for all sorts of rich data.

WINNER

NEC InterSect CDR-74

Rick Hayatsu, Michael Kaiser-Gorczak, and the Advanced Media Team



CD-ROM players look considerably more attractive when they're fast enough to keep up with the demands of data retrieval. NEC's InterSect CDR-74 CD-ROM reader offers a new MultiSpin technology. Instead of spinning the platter to sustain a constant linear velocity of 75 sectors per second, NEC has doubled the spin rate to 150 sectors per second. This speed-doubling allows the InterSect CDR-74 to play back data at twice the speed of previously marketed CD-ROM drives. Still, the unit is smart enough to switch back to a slower speed for audio information. Lucky users can now get the best of both worlds: performance and compatibility.

▶*NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; 800-632-4636, 708-860-9500.*

FINALISTS

Kodak Photo CD system

Scott Brownstein, John Osterhout, Stephen Stepnes

In 1992, Eastman Kodak Co. brought its Photo CD technology into the PC arena, offering the promise of an inexpensive, highly available digital format for storing, editing, and retrieving camera images. Kodak's system will let you take your ordinary 35mm film into a Photo-CD-equipped finishing shop and walk out with as many as 100 images stored on a CD-ROM. These can be played back from almost any CD-ROM XA drive that is capable of multisession recording (multisession lets you append the image to the end of your CD). Kodak has special software offerings to let users crop, rotate, and zoom images, but other standard PC image editing software is also beginning to support the new image format.

Photo CD is well on its way to becoming a standard file format. While none of these technologies are new, bringing the bundle—from film to CD—together in a mass-market product could bring photographic images into a wide variety of PC applications.

▶*Eastman Kodak Co., Kodak Information Center, 343 State St., Rochester, NY 14650; 800-242-2424.*

Philips CDD 521 Desktop CD Recorder

Philips Interactive Media Systems Design Team

Unlike other CD-ROM drives that are just writable in a single session, Philips drives are appendable, which means you can use them like any other media and keep adding to them, allowing for multisession recording. Philips also was among the first to deliver double-speed recording. The recording speed and the fact that you append the disk make the Philips CDD 521 a breakthrough product for those who want to produce low-cost CDs. It's also ideal for those who want to use the more than 600MB of CD-ROM storage as a workaday storage medium. However, since it can't play back audio CD and because users cannot overwrite sections previously recorded, there's still some room for improvement—a challenge, perhaps, for those seeking next year's award.

▶*Philips Consumer Electronics Co., 1 Philips Dr., Knoxville, TN 37914; 800-835-3506.*

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Version 5 availability: Spanish 10/92, French 11/92, German 12/92, Italian 2/93

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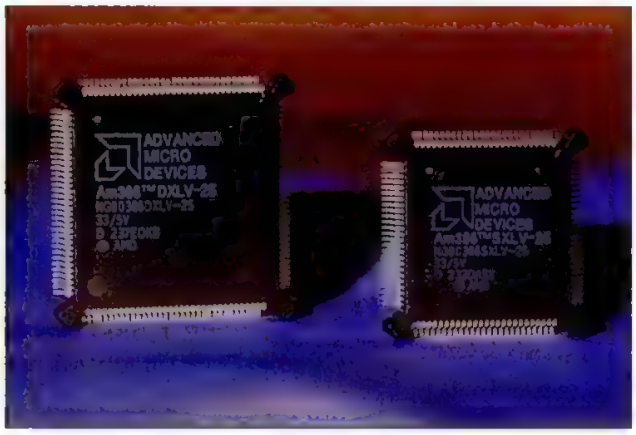
COMPONENTS/SUBSYSTEMS

In computer synergy, the sum of the parts is always greater than the whole. The PC is the sum of many parts—hard disk, battery, processor, display, video, and more. This year's winners each took their slice of the computer pie and then tweaked and tuned and reengineered until their products shone.



WINNER

AMD 3.3-volt CPUs

Ben Oliver and the Longhorn Team

Power consumption is one of the major barriers for the more powerful peripherals and notebooks. It's a simple fact: The larger the hard disk and the brighter the screen, the heftier the power supply. And when space is at a premium, creating a strong power supply is an even tougher job.

AMD (Advanced Micro Devices) pioneered the first 3.3-volt designs in its 386 CPU chips, the Am386DXLV and Am386SXLV. These chips need as little as 40 percent of the power required by the more standard 5-volt components. These lower-power chips will lead to portables with smaller batteries and, perhaps, longer lives as well.

The emergence of 3.3-volt CPUs will inevitably be followed by the emergence of low-voltage memory chips, drives, video controllers, and others. Intel Corp. is the second to pursue this technology, but AMD cleared the path.

▶*Advanced Micro Devices Inc., 901 Thompson Pl., P.O. Box 3453, Sunnyvale, CA 94088; 408-732-2400.*

FINALISTS

ATI Graphics Ultra Pro

Adrian Hartog, Arthur Lai, Benny Lau, Lee Lau, Fred Wiegel, and the mach 32 Development Team

The newest of the ATI line, the Graphics Ultra Pro board includes ATI's mach 32 68800 chip—the latest and greatest in a long line of ATI video chips. The new 32-bit chip offers Windows acceleration with a difference: It uses 64-bit internal instructions for some operations, linear addressing to up to 4MB of video RAM, and internal font caching. The result is a graphics board that is significantly faster than anything we've tested. ATI also provides true-color support, multiple resolutions, and its unique font display technology. It always takes ATI a few attempts to get the bugs out of their drivers, and the Ultra Pro does have some glitches. But its hot technology ensures top video performance.

▶*ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; 416-756-0718.*

HP Kittyhawk Personal Storage Module

Rick Seymour, Bruce Spenner, Jeff White

Honey, I shrunk the hard disk! Like just about every other component in the PC market, hard disk drives have gotten smaller yet more powerful over the years. In a year when 2.5-inch drives were the standard for desktop computers, and 1.8-inch drives were in vogue for notebook designs, Hewlett-Packard took miniaturization a step further. The size of a matchbook, HP's new Kittyhawk drive is the world's first 1.3-inch hard disk drive. Its low power consumption and durability are also keys to its success.

The Kittyhawk is now only available in limited quantities, and its capacity is limited to 20MB, but we expect

The best word processor for Windows is by Lotus.

Says who?

this is only the beginning. These drives will enable a whole new class of palmtop-size personal communicators that should appear shortly.

▶*Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-637-7740.*

Intel DX2

Bob Beutler, Jim Conary, John Deetz, Sha Gleason, Steve Griffith, Rich Jolly, Chris Jones, Wes McCullough

Getting a computer that's twice as fast, without having to buy a new machine: Now that's definitely progress.

Intel's new clock-doubling chips breathe new life into existing 486 class machines. These chips handle internal processing at twice the speed that processing for external connections to devices and memory is handled.

The beauty of this technology is that system manufacturers can use their existing motherboard designs and still get faster performance—and at a reasonable price.

Clock-doubling technology has been around for a while, but Intel brought it to the PC platform. This speed-doubler technology enables Intel's 486DX2-66 chip to surpass by more than 25 percent the processing speeds of the 486DX-50 chip, formerly considered the most powerful microprocessor available for personal computers.

▶*Intel Corp., 2200 Mission College Blvd., Santa Clara, CA 95052; 800-346-3028.*

Development Tools

Tools for developing applications are always improving. We're just beginning to learn how object-oriented techniques, visual development environments, and strong languages can reduce the development cycle of a project.

WINNER

Borland C++ 3.1

The C++ Development Team

Borland International continues to make the C/C++ environment a smoother, more fluid place to develop applications. Simply put, the C/C++ environment is the best programming environment on the market today. Borland's latest release of the Application Frameworks, C++ 3.1, includes many more ObjectWindows components—including OLE, Multimedia, and drag-and-drop—to ease the process of sophisticated applications development. Borland C++ 3.1 also was the first fully Windows-hosted integrated development environment for C++, a real step forward in easing creation of Windows applications. With color syntax highlighting, new optimizations, and integrated resource compilation added to this version, Borland C++ remains on the cutting edge.

▶*Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877.*

FINALIST

Microsoft Visual Basic Programming System for MS-DOS

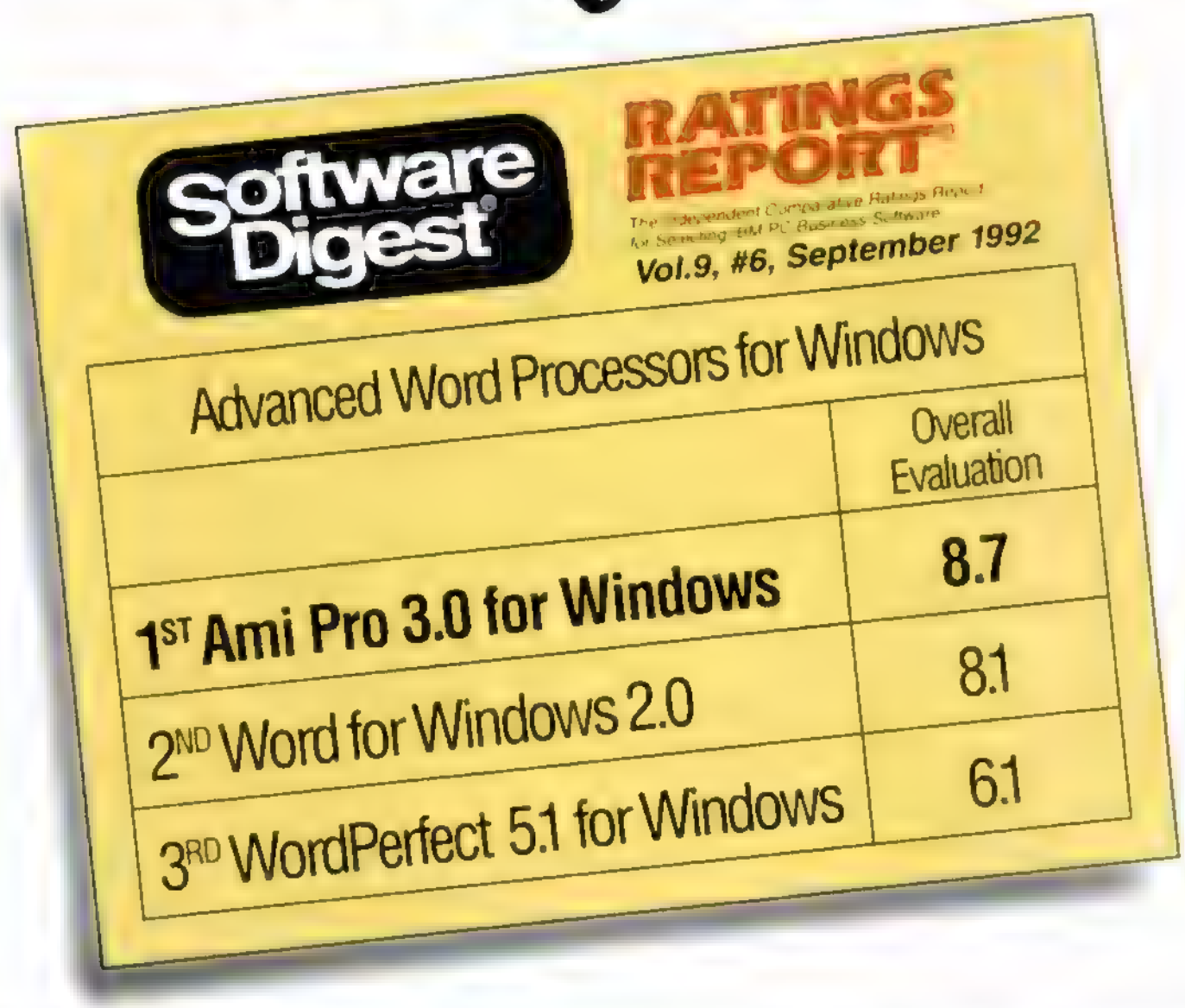
Barry Bond, Mark Chace, Jose Luis Gonzalez, Tim Keane, Ted Liuson, Scott Pehrson, Ramamurthy Suresh

With last year's Microsoft Visual Basic for Windows (a Technical Excellence Award winner), Microsoft brought visual programming to the mainstream. Visual Basic proved that you could create a very powerful application primarily based on icon, mouse clicks, and other visual methods while still allowing more complex programming through Basic.

Now the new version of Basic is available for DOS as well, and it's hard to believe that this is really a DOS application. The new version uses the identical visual programming model, the same robust collection of objects, and a compatible programming language. Applications can be compiled into standalone executables; no runtime library is required.

▶*Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

They do.



The most respected and objective evaluator in the software industry concluded, "Lotus® Ami Pro® 3.0 offers an unbeatable combination of peerless usability, top-level features and fastest overall performance."

Ami Pro 3.0 earns the highest overall evaluation for Windows word processing.

In recent tests conducted by the National Software Testing Laboratories (Software Digest), Ami Pro 3.0 received the highest Overall Evaluation in the Advanced Word Processors for Windows "category. Plus, InfoWorld gave Ami Pro the highest score ever (8.9) for a Windows word processor. Even a tenth of a point means a big difference in these evaluations.

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INFO WORLD
RECOMMENDED PRODUCT
9/28/92

"Ami Pro stands out as the most usable program with the best performance."
Software Digest Ratings Report

"Ami Pro answers all the formidable challenges that Word for Windows 2.0 laid down and presents some new challenges for Microsoft to wrestle with."
PC/Computing (8/92)

"Ami Pro 3.0 takes the lead over Microsoft Word as the Windows word processor to beat."
InfoWorld (9/28/92)

Ami Pro 3.0 earned top scores in performance, ease of learning and ease of use.

According to test results published in Software Digest® Ratings Report, Volume 9, Number 6, September 1992, "The latest Ami Pro version manages to be powerful and feature rich, yet it is exceptionally easy to learn."

One evaluator quoted in the Ratings Report said, "Ami Pro is the kind of program that I'd like to go out and buy right away. It's that easy and it did that much."

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Ready to discover why the evaluators rated Ami Pro #1? Just call for your free Working Model at **1-800-872-3387, ext. 7135.** Or better still, upgrade from your current word processor* for just $129 and take advantage of our free 24-hour support and 60-day money back guarantee. You'll see why this peerless, award-winning word processor for Windows is now the best word processor money can buy.

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CIRCLE 143 ON READER SERVICE CARD

As they say, it's all in the genes. Introducing the ThinkPad™ from IBM. The slickest, sleekest little number that ever crunched one. A mere seven-and-a-half pounds of brains and beauty that begs you to take it anywhere. And once you own one, that's exactly what you'll do.

All this in only 11.7."

Introducing

ThinkPad

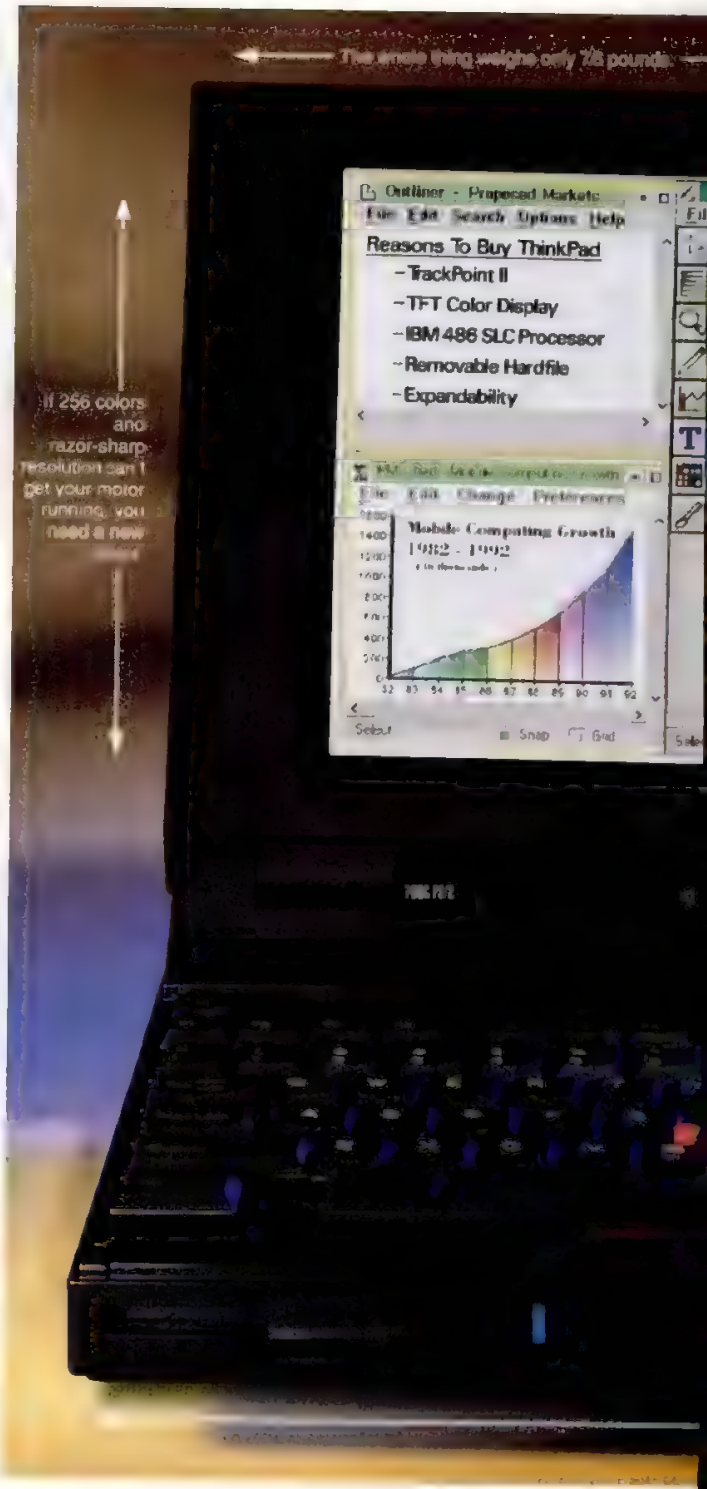
The top-of-the-line ThinkPad 700C sports a screaming 486 SLC™ 25 MHz processor. But it's built for comfort too. There's a surprisingly roomy interior, with a full-size, ergonomically designed keyboard. And a screen that literally bends over backwards.

Strategically placed on the keyboard is a little red spot called the TrackPoint II.™ It does what a mouse would do with a few million more years of evolution. Nothing dangles; it's part of the soul of the machine. You can operate it with one fingertip. And it lets you think on any terrain, even one without any flat surfaces.

The ThinkPad's screen is a thing of almost aching beauty. Its 640 × 480 VGA resolution is sharper than that of many desktop computers. It displays 256 colors. And it's the biggest screen on any notebook. So it's very easy on the eyes.

The ThinkPad comes standard with things some other notebooks don't even offer as options. Like 4MB

*Depending on usage and configuration. **MSRP. Dealer prices may vary. †Warranty information available from the Personal Systems HelpCenter or an IBM authorized dealer. 700T warranty is available in USA and Canada only. ††In Canada, call 1 800 465-7999. IBM is a registered trademark and ThinkPad, HelpWare, HelpCenter, SLC and TrackPoint II are trademarks of International Business Machines Corporation. PRODIGY is a registered trademark of Prodigy Services Company. © 1992 IBM Corp.



Its mother was
Its father wa

of memory upgradable to 16MB. 120MB of hard disk space. Pre-installed DOS 5.0 and PRODIGY.* You can soup it up with a turbo-charged 486SLC2 50/25 MHz processor—just one of the upgrade products IBM offers. And the hard disk is removable, so it's easy to upgrade and share your ThinkPad, not to mention the great security and virtually unlimited storage.

The world's smallest stick shift.

ThinkPad blows the doors off its competition in an even more surprising arena. Price. Any ThinkPad in the line will give you more for your money—and for your psyche—than any other notebook.

If you have questions along the way, ThinkPad Models 700C and 700 are supported by HelpWare,™ an invaluable service package that includes a three-year international warranty.†

ThinkPad	Model 700C	Model 700
Processor	486 SLC/25 MHz	486 SLC/25 MHz
Display	10.4" Active Matrix 256-Color Screen	9.5" Monochrome Display 64 Grayscale Screen
Battery Life*	2–4 Hours	3.8–7.5 Hours
Weight	7.6 Lbs. with Battery	6.5 Lbs. with Battery
Warranty	3 Years (International)	3 Years (International)
Price**	$4,350	$2,750

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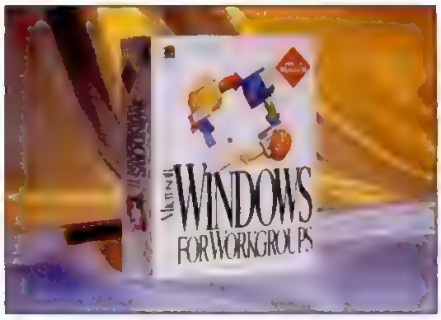
CIRCLE 024 ON READER SERVICE CARD

NETWORKING/COMMUNICATIONS

With new nodes being connected at a rate estimated at 30,000 a day, the modern adage, "If you're not connected, you're not computing," has never rung more true. And the myriads of ways that users are being connected—such as Windows, wireless channels, or long-distance WANs (wide-area networks)—are richer than ever.

WINNER

Microsoft Windows for Workgroups



Thomas Fenwick, John Ludwig, and the Windows for Workgroups Team

By combining peer-to-peer networking, electronic mail, network calendar management, and Windows in a single product, Microsoft has taken the kinks out of networking. As a peer-to-peer network, sharing information on your hard disk with others in a group becomes trivially easy. And because of the product's close ties with NetWare, many of the irritations of Windows' life on the file server are also eliminated.

Microsoft Windows for Workgroups' technical innovations include automatic detection and setup for most network cards, the use of 32-bit protected mode network drivers, and Network Dynamic Data Exchange, which lets users exchange data between applications even over a network. The product also lets you smoothly attach to multiple servers and multiple networks simultaneously, including other Windows for Workgroups, NetWare, and LAN Manager systems. And Windows for Workgroups includes features for transparently detecting available servers on multiple networks.

▶*Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

FINALISTS

DigiBoard IMAC

Dror Kessler and Hammond Mathews

DigiBoard's new LAN-to-LAN link is an ISDN MAC-layer bridge that weaves two communications technologies, Ethernet and ISDN, into a flexible Inter-LAN span. DigiBoard IMAC has the look and feel of a modem, but the similarity stops there. During operation, the IMAC can look for Ethernet packets addressed to nodes on distant LANs. When it recognizes traffic bound for a distant LAN, the IMAC initiates an ISDN connection to the appropriate IMAC anywhere in the world.

Setting up an ISDN call takes no more than a few seconds, and you can adjust the calls' duration to suit the applications. The most unusual aspect is that IMAC can automatically call up and parallel additional ISDN circuits to increase bandwidth or establish multipoint links.

▶*DigiBoard Inc., 6400 Flying Cloud Dr., Eden Prairie, MN 55344; 612-2943-9020.*

Mobidem M1090 Portable Wireless Modem

Roland Johansson, Anders Torstensson, Stefan Ulveland

Connected but not tied by an umbilical cord. That's the direction we're heading as wireless communications find their ways into new portable computers. One of the most intriguing is Ericsson's new Mobidem M1090 Portable Wireless Modem, which lets you transmit and receive messages via packet radio in most major cities. The modem is fairly large, communications are pricey, and the packet radio infrastructure is not fully in place yet, but this product is a sign of things to come.

▶*Ericsson GE Mobile Communications Inc., 15 E. Midland Ave., Paramus, NJ 07652; 201-265-6600.*

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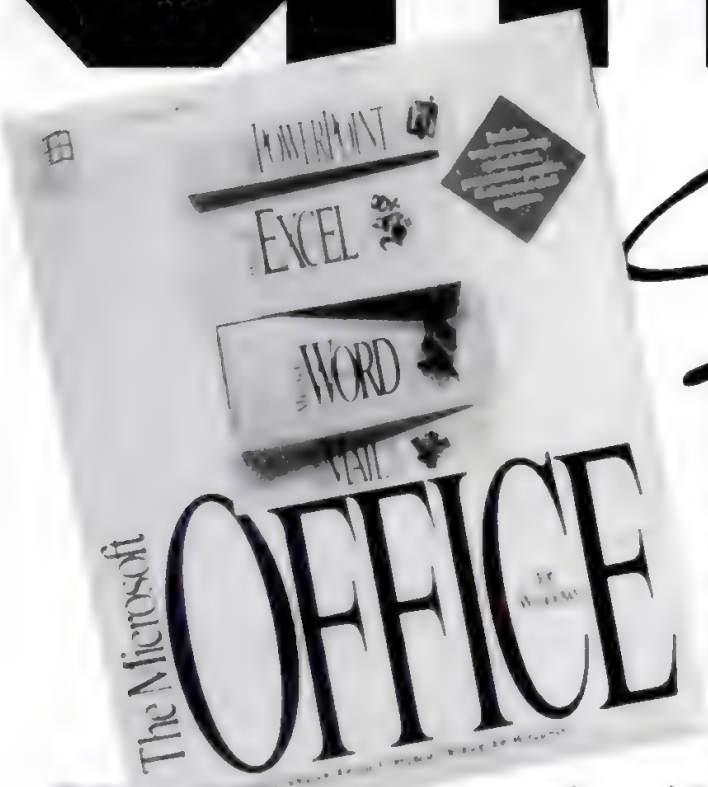

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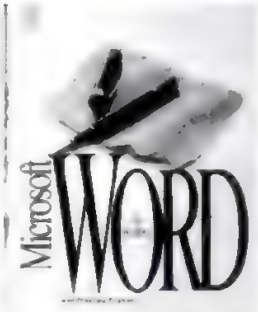

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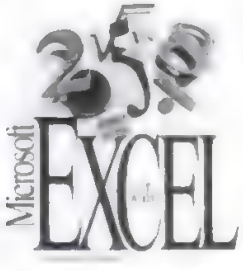

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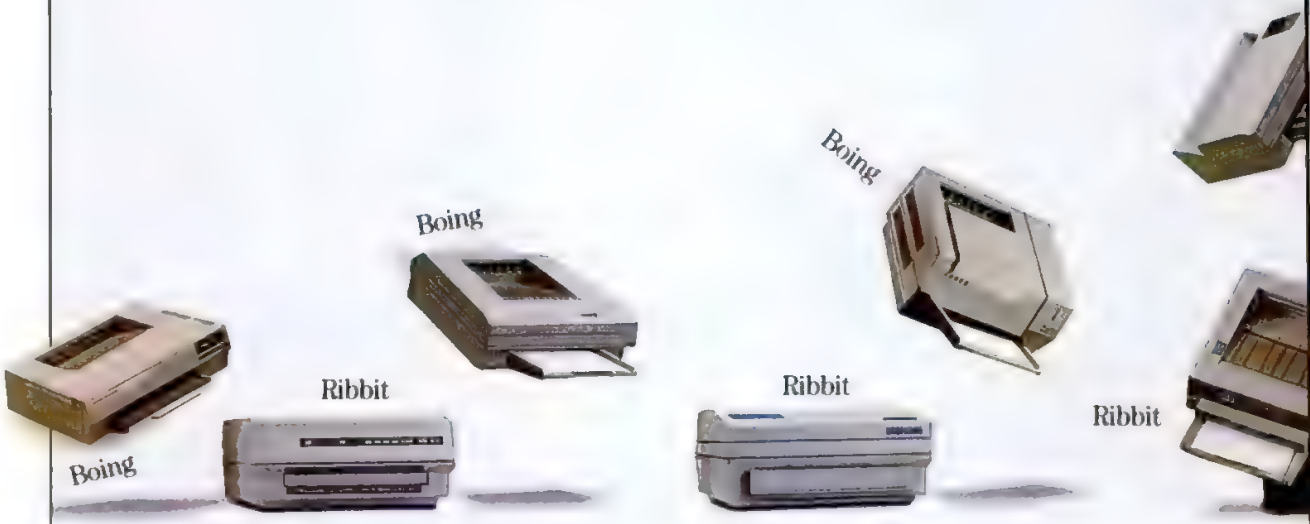
SOFTWARE SPECTRUM

CIRCLE 282 ON READER SERVICE CARD

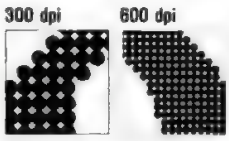
Other laser printers play leapfrog trying to catch up with the HP LaserJet.



The new HP LaserJet 4 printer isn't a hopped-up version of the past generation. Its new, advanced design sets much higher standards for print quality, speed, built-in features and value than ever before.

Higher resolution. More typefaces.

Unlike other 600 dpi laser printers, the HP LaserJet 4 was designed for 600 dpi printing from the ground up. As a result, it produces the best 600 x 600 dpi resolution ever for noticeably crisper, clearer text and graphics. At less than a 300 dpi price.



Four times the dots for better resolution.

Microfine toner and HP's exclusive Resolution Enhancement technology give you razor-sharp edges and much smoother curves.

With 45 scalable typefaces built into the printer, users can produce a wide variety of documents. Without hassling with downloading or accessory cartridges. Or buying additional typefaces.

More speed, more trays, more flexibility.

Thanks to a new RISC processor, tuned vector graphics and faster I/Os, the HP LaserJet 4 also sets new standards for speed. It even prints many 600 dpi graphics at a true 8 pages per minute. It's faster on networks, too.

With 2 MB of memory built in and new internal memory compression algorithms, virtually all 300 dpi and many 600 dpi documents print from standard memory. Two standard paper trays, with a total capacity of 350 sheets, and an optional 500-sheet tray let users keep printing without constantly reloading different sizes and types of paper. And the optional 75-capacity power envelope feeder saves them from manual feeding. Or dealing with jams.

©1992 Hewlett-Packard Company PB12274

Introducing the new HP LaserJet 4 printer. So advanced, there's no catching it.

Mixed environment compatibility. Faster Windows.
The LaserJet 4 is very much at ease with most languages and personal computing platforms. Automatic switching lets it switch between HP's PCL 5 printer language and optional PostScript Level 2 software from Adobe. Hot I/Os allow different hosts to be connected simultaneously.

Optional JetDirect cards provide LAN connections to Ethernet, TokenRing, TCP/IP and LocalTalk, EtherTalk. This makes it easy to plug into just about any network, including PC and Mac LANs. And to get really fast network performance.

To optimize the LaserJet 4 for Windows printing, we codeveloped some breakthroughs with Microsoft.* Including Windows 3.1 TrueType fonts and rasterizer built in to make sure your users get fast, WYSIWYG printing. The fast Windows driver with HP-GL/2 vector graphics also enhances printing speed.

Several popular software drivers are included: Windows, WordPerfect and Lotus. As well as the new HP Explorer PC utility software, which provides a printing tutorial to guide your users through set-up and operation of the printer's new features.

All this makes the HP LaserJet 4 printer supremely simple to plug-and-play. As you'd expect, it also offers complete document and software compatibility with the HP LaserJet III printer.

Setting the standard in price, too.
With all these advances and more, you'd expect a big jump in price. Quite the opposite. At just $2,199,* the HP LaserJet 4 printer lists for less than the printer it replaces. And, of course, it comes with pace-setting HP quality and reliability.

Call **1-800-LASERJET** (1-800-527-3753), **Ext. 7133** for the name of your nearest authorized HP LaserJet dealer.† And ask for a print sample to see just how great the output looks.**

If it isn't a LaserJet 4, it's only a laser printer.

HEWLETT PACKARD

*Suggested U.S. list price. †In Canada call 1-800-387-3867, Ext. 7133. **To have a LaserJet 4 printer data sheet sent immediately to you via fax machine, call 1-800-964-1492 from your touch-tone phone. Microsoft is a U.S. registered trademark of Microsoft Corp. Windows 3.1 is a product of Microsoft Corp. Adobe and PostScript are trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. Lotus is a U.S. registered trademark of Lotus Development Corporation.

APPLICATIONS

A pinch of this and a touch of that. . . .Software innovation involves a sometimes subtle combination of programming code, concept, and user interface.

WINNER

Quattro Pro for Windows

Bob Warfield and the THOR Development Team

If you didn't believe that a spreadsheet program could still be innovative, Borland International's new Windows spreadsheet package will most certainly make a believer out of you.

Quattro Pro for Windows is utterly packed with new ideas. Most obvious is the notebook metaphor, in which every spreadsheet has multiple pages indicated by notebook tabs. This lets you do everything from naming pages to separating functional components, such as macros and formulas. The new package also lets you combine pages into groups for consolidation.

Additionally, Quattro Pro for Windows introduces Object Inspectors. By clicking on the right button, you are instantly privy to all sorts of information about your worksheet, which might otherwise have required you to run through a multiple series of menus. Changing a property such as a font or color is virtually effortless, be it in a cell, a block, or even a graph. A Database Desktop, which was borrowed from the upcoming Paradox for Windows, brings a graphical Query By Example metaphor to Windows spreadsheets.

▶*Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-0877.*

FINALISTS

Approach 1.0 for Windows

Kevin Harvey and the Approach 1.0 Development Team

It's a simple nonprogrammable database, but don't be deceived by its simplicity. Approach 1.0 brings an easy-to-use graphical interface to meaty relational databases. It offers painting and visual tools for creating reports and forms, and then lets you use those forms on a single machine or on a network using standard database files. You can place and resize bitmaps and graphics in forms and reports and add push buttons and Windows controls without knowing anything about programming. You can create one to many relationships, show multiple windows, and navigate through your database with VCR-style buttons.

In short, Approach makes designing usable, attractive relational databases a manageable task.

▶*Approach Software Corp., 311 Penobscot Dr., Redwood City, CA 94063; 800-277-7622.*

Microsoft Excel for Windows, Version 4.0

Darrell Aldrich, Mike Conte, Jon DeVaan, Chris Graham, John Hopper, Tim McGuire, Navneet Paliwal, Marc Olson

Microsoft Excel has always been innovative, and Version 4.0 keeps up the trend. Last year, Excel 3.0 was a Technical Excellence Awards finalist, thanks to innovations such as the Autosum feature and integrated spreadsheet outlining. This year, Excel 4.0's drag-and-drop for moving cells or ranges, its Autofill feature for extending a series, and its series of predefined formats are new touches already being widely imitated. This version also has several unique features, including a Wizard for making crosstabs easier and a built-in spell-checker.

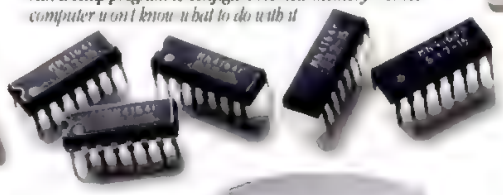
▶*Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

If you're looking for a computer that will grow with your needs, there are basically only two ways you can go.

The hard way.

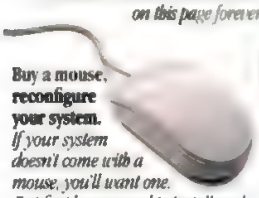
Add networking card, reconfigure your system. *To share files and send e-mail to other PCs, you may have to add a card. This means going through the long, tedious process of reconfiguring your system. On a Mac, you just plug in a cable.*

Upgrade your memory, reconfigure your system. *Add memory to a Mac, and it reconfigures itself accordingly. But add memory to a PC, and you'll almost always have to run a setup program to configure the new memory – or the computer won't know what to do with it.*



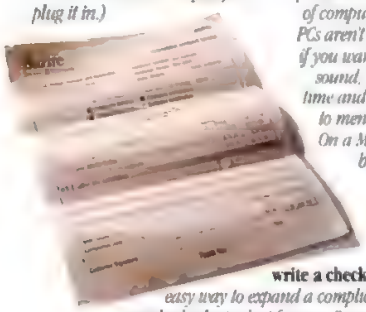
Add Windows, buy a new PC. *Most PCs in use today weren't designed for graphical computing. So if you want to run Windows, you may have to buy a new computer. Why not consider a Macintosh and avoid all the problems on this page forever?*

Add almost anything, reconfigure your system. *Expanding your PC's capabilities can be amazingly frustrating. But a Macintosh easily adjusts to whatever extra device you add to it.*



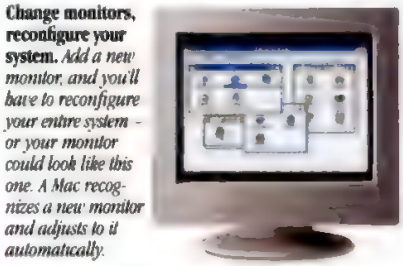
Buy a mouse, reconfigure your system. *If your system doesn't come with a mouse, you'll want one. But first be prepared to install and configure a special software driver. (No need with a Mac – you just plug it in.)*

Play and record sounds, reconfigure your system. *Multimedia promises to be the future of computing. But most PCs aren't ready for it. So if you want to work with sound, it'll cost you time and trouble – not to mention money. On a Mac, sound is built in.*



Call for help, write a check. *There is one easy way to expand a complicated PC – hire somebody else to do it for you. Over time, of course that can wind up costing you more than the PC.*

Expand your PC, take two aspirin. *Inevitably, you'll want to expand your computer's capabilities by adding extra devices. The more instructions you slog through and switches you fiddle with, the more time it will take. And the more pain reliever you'll need.*



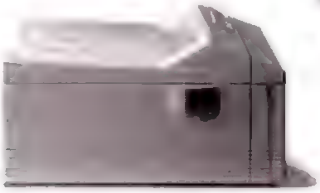
Change monitors, reconfigure your system. *Add a new monitor, and you'll have to reconfigure your entire system – or your monitor could look like this one. A Mac recognizes a new monitor and adjusts to it automatically.*

Whoops! *When you add something to an ordinary PC, you may have to "reconfigure" your system – a process of hardware and software adjustments, which can be complex, tedious, and take up hours of your time.*

Add peripherals, reconfigure your system for each one. *Want to add a CD-ROM or hard disk drive? Then prepare to spend hours installing cards, flipping switches and editing files – for each one. With a Mac, you can add up to seven peripherals by simply plugging them in and clicking a button or two.*

Manual labor. *Software like Windows purports to make things easier. But the reality is, you'll still spend hours reading manuals just to make it all work – time you could spend doing more useful things with your computer.*

Add printer, adjust DIP switches. *Hooking up a printer seems easy. Until you set your DIP switches, install your driver, locate your Windows diskettes, make an error and start all over again.*



On a typical PC, even adding a simple hard disk can be extraordinarily complicated. You'll probably have to "reconfigure" your system – the time-consuming process of telling your computer what pieces you've added. You may have to edit complex CONFIG.SYS and SYSTEM.INI files, install special device drivers and fiddle with DIP switches. And, of course, building even a basic network is extremely difficult – what with installing

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CIRCLE 071 ON READER SERVICE CARD

Suitability to Task: Monochrome Portables

Five of the monochrome systems we reviewed—the TI TravelMate 4000 WinSX/25 and WinDX/25, Polywell's Poly NBC25, the Jetta Jetbook 486DX/33, and the Compudyne Slimnote 486SX/25-80—notably combined the light weight, long battery life, and high-speed communications devices required to be good traveling companions.

Most units fell short in several categories. Only the Compaq LTE Lite/25E, with its revolutionary active-matrix monochrome LCD screen, could accurately display the colors used in Microsoft Windows as realistic shades of gray. And only three of the monochrome notebooks—the Altima 433 80486DX, the Compudyne Slimnote 486SX/25-80, and the Twinhead Slimnote 486DX/33—were considered suitable for use as desktop replacements.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Road warrior/communications indicates how complete a traveling companion each portable is. A unit was rated as ***excellent*** if it combined in a small package light travel weight (no more than 7 pounds, including AC adapter and battery), long battery life (at least 3 hours with power-conservation features enabled), and good communication options (such as a 9,600-bps data/fax modem or a PCMCIA card).

DOS applications measures each system's ability to run DOS software quickly. To rate ***excellent*** in this category, a system must have at least a 25-MHz 386 processor, as well as an 80MB hard disk or larger, a display that measures at least 9 inches diagonally, and a DOSmark score in the top 25 percent on PC Magazine Labs' Hardware Benchmark Tests, Release 7.0.

Windows applications are extremely demanding, requiring a combination of processor speed and high-volume data storage. To be worthy of a top rating in this area, a unit should have system memory that can be expanded to at least 8MB, a 120MB hard disk available, Graphics Winmark and Disk Winmark scores in the top 25 percent, a built-in pointing device, and power management that works under Windows. Image quality was also a criterion.

To be considered a suitable **desktop replacement**, a system has to be capable of internal expansion or have a docking station available, offer a 120MB hard disk or larger, and support Super VGA graphics on an external monitor. We also consider the portable's keyboard and whether an external keyboard can be plugged in.

operating, but the company claims that its nickel cadmium battery pack can be fully recharged in 2 hours and lasts for up to 4.5 hours of use. On our tests, the battery lasted only 1 hour 56 minutes with power conservation turned off (user-adjustable display, hard disk, and system timeouts, along with a standby button and a CPU power-down preset to 3 minutes); with power conservation, it managed 3 hours 2 minutes in ZDigit testing.

SUITABILITY TO TASK

AcerAnyWare V386SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

This portable's Sharp screen is capable of VGA resolution with 32 shades of gray, and it can simultaneously support an external Super VGA monitor at 16 colors.

The edgelit TSTN (triple-supertwist nematic) panel is slightly dark under DOS but brightens under Windows. Acer's 82-key keyboard has 12 half-height function keys and separate PgUp, PgDn, Home, and End keys; cursor keys, in an inverted-T layout, are too close to Home and End.

The AcerAnyWare produced an above-average DOS video score but a poor Graphics Winmark result. The portable's memory and processor scores were average, and its disk scores were well above the average.

The AcerAnyWare V386SL

The company includes a one-year parts-and-labor warranty, along with a 24-hour replacement policy for the first year.—*Robin B. Bornstein*

Advanced Logic Research Inc.

ALR Ranger M425s-120
ALR Ranger MC425-120
ALR Ranger M425-120
ALR Ranger MC425s-120

There are two choices to make when it comes to Advanced Logic Research's notebooks: 486SX or 486DX, and color or monochrome. ALR's Ranger series have easy CPU upgradability and a large array of internal options, but they are heavier than average.

The four Rangers were equipped identically except for their processors and screen technologies. Each computer came with 4MB of RAM and a 120MB Toshiba hard disk. Of the two 486SX/25 models, the $2,890 ALR Ranger M425s-120 has a passive-matrix monochrome screen, and the $3,890 ALR Ranger MC425s-120 comes with a passive-matrix color screen. The higher-powered ALR systems each had a 486DX/25 CPUs and passive-matrix screens: The monochrome ALR Ranger M425-120 costs $3,390, and the color ALR Ranger MC425-120 costs $4,290.

If you want to save money initially, buy one of the 486SXs and then upgrade to a 486DX. (The color and monochrome 486SXs cost $400 and $500 less than their 486DX versions, respectively.) Upgrad-

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Price/Performance Index: *Monochrome Portables*

Roughly one-quarter of the 60 monochrome portable PCs we tested for this issue—16 of them—featured Intel 486 microprocessors, and as might be expected, those units dominated the high-performance area of our price/performance chart. The TI TravelMate 4000 WinDX/25 and WinSX/25, along with the Aspen Aquiline 433, were performance leaders and fell in the upper price range. The leading price/performers in the 486 class were the Lightning Thundernote 486DX/33, the Compudyne Slimnote 486SX/25-80, and the Primax Eagle 425SX.

Five systems used the Cyrix 486SLC/25 chip. The CompuAdd Express 425CXL-80 and Keydata's Keynote 486SLC scored respectably on price/performance; the other three Cyrix-based entries—the Tandy 3800 HD, the GRiD 1755 486SLC, and the Wyse DecisionMate 486SLC—fell in the mid to low region of the 386SL/25 performance area, with closely clustered prices.

Leading 386-class price/performance entries include the Micro Express NP933—which was the only system to use the AMD386DX/33 chip—and the Compudyne Slimnote 386SL/25-80

Four systems priced under $1,700 provided performance that was low but reasonable enough to be worth a close look: the Primax NightHawk 325SXL ($1,449), Keydata's Keynote 386SX-25 ($1,595), the Compaq Contura 3/20 ($1,608, discounted), and Polywell's Poly NB325T ($1,695). The rest of the 386-based systems were generally clustered in the middle of the group's performance range, within a $1,000 spread between $1,700 and $2,700

THE DATA POINTS

This chart plots each system's selling price (*y*-axis) versus its performance index (*x*-axis). We discounted systems available only through dealers by 15 percent.

The performance index reflects numerous features. DOSmark, Graphics Winmark, and Disk Winmark scores account for 35 percent of the rating; system memory and hard disk size, 16 percent; and the size, weight, and ZDigit Rundown test score (battery life), 11 percent each. The remaining 16 percent is based on display size, I/O ports, PCMCIA slots, internal modem, simultaneous external display capability, super VGA output, extra cursor keys, built-in pointing device, flash BIOS provision, ROM power-conservation features, 16550 UART support, enhanced parallel port, and hot-swap battery change capability. For details, see 22MBANG WK1 in the Software Library of PC MagNet's Editorial Forum.

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The ill-fated "Rhapsody for Subsonic Tubas" was performed only once by Frederick Von Stuckman. The notes were so low, no one could hear them. Requests for encore performances were subsequently low.

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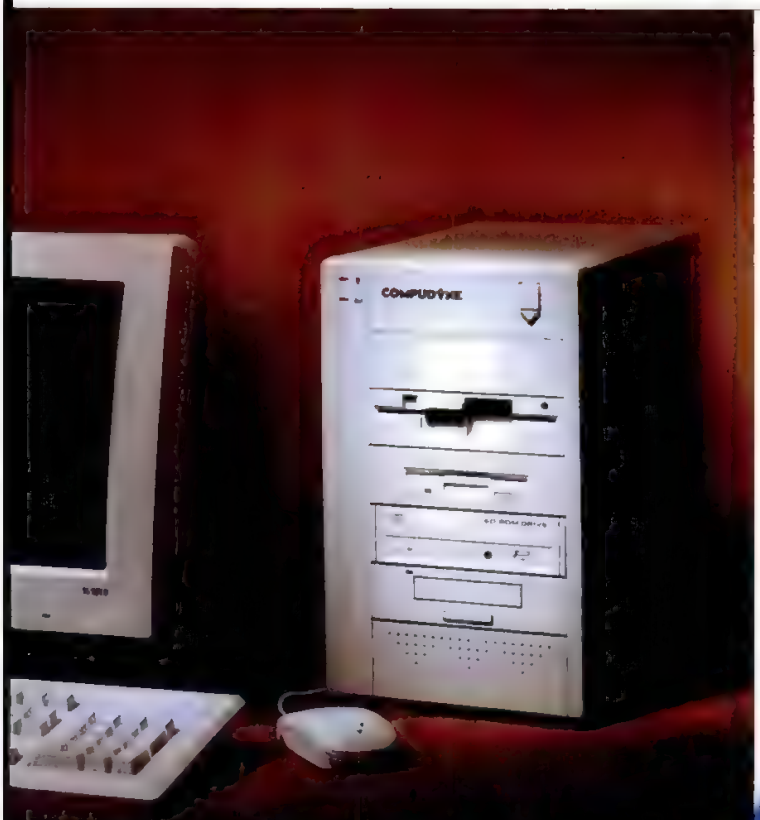

Desktop	CPU	RAM (MBs)	HD (MBs)	Floppy	Display	Price
386DX/33	Intel 80386DX-33 MHz	1 standard 32 max	40	1.2 or 1.44	16 bit SVGA card 14" 640x480 VGA Color Monitor	$849** $32/mo*
386DX/33 or 486SX/25	Intel 80386DX-33 MHz or Intel 80486SX-25 MHz, with built-in 8K CPU cache	2 standard 32 max	80	as above	as above	$999 $37/mo*
486SX/25	Intel 80486SX-25 MHz Built-in 8K CPU cache	as above	80	1.2 & 1.44	16 bit SVGA card 14" 1024x768 SVGA Color Monitor	$1,199 $44/mo*
386DX/33 CACHE	Intel 80386DX-33 MHz 64K CPU cache	4 standard 32 max	120	as above	16 bit SVGA card & Hi-Color Support, 14" 1024x768 SVGA .28 Interlaced Color Monitor	$1,399 $52/mo*
486SX/33	Intel 80486SX-33 MHz 8K CPU cache	as above	120	as above	as above	$1,499 $56/mo*
486DX/33 CACHE	Intel 80486DX-33 MHz 128K CPU cache	as above	120	as above	16 bit SVGA card, 1MB Video RAM & Hi-Color Support, 14" 1024x768 SVGA Non-Interlaced Multisync Color Monitor	$1,799 $67/mo*
486DX/50 CACHE	Intel 80486DX-50 MHz 128K CPU cache True 50 MHz CPU	as above	120	as above	as above	$1,999 $74/mo*
486DX2/66 CACHE	Intel 80486DX2-66 MHz 128K CPU cache New Double Clock CPU	8 standard 32 max	200	as above	16 bit SVGA Superfast Windows Accelerator card, 1MB RAM, 14" 1024x768 SVGA Non-Interlaced Multisync Color Monitor	$2,499 $93/mo*

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CIRCLE 132 ON READER SERVICE CARD

The ALR Ranger MC425-120, MC425s-120, M425s-120, M425-120

ing from a 486SX to a 486DX is simple with an optional $699 486DX/25 module: Loosen two screws, remove a panel and the old CPU module, plug in the new one, replace the panel, and tighten the screws.

The plastic Ranger case appears rugged, but when we tested these four systems, one unit's case cover release broke off, and the battery release slide button on another machine came loose. With a battery installed, each of the four Rangers weigh from 7.4 to 7.8 pounds. The 1.2-pound AC adapter increases the total traveling weight to the 8.6- and -9 pound range. An extra battery pack weighs 1.8 pounds. Because of their weights and size (slightly larger than average at 2.3 by 11.8 by 8.5 inches), the ALR Rangers are not designed for casual carrying.

The four 486-based Rangers performed well in terms of the entire roundup. Within their respective processor categories, however, they were average performers. The SX color machine registered a sour note in terms of its Graphics Winmark score.

ALR claims that with power conservation, the nickel cadmium batteries will last 3 to 4 hours for both the color and the monochrome versions. On PC Labs' Battery Rundown test with power conservation disabled, the SX monochrome system lasted the longest (2 hours 32 minutes); next came the DX monochrome unit (2 hours 26 minutes), the DX color model (2 hours 6 minutes), and the SX color system (1 hour 46 minutes).

Power conservation includes a processor sleep mode, an autofast mode, and variable time-out settings to suspend the hard disk, LCD, and processor. The power-management settings are easily accessed and changed through a CMOS setup utility.

The monochrome Rangers use edgelit supertwist Sharp LCD screens measuring 8.5 inches diagonally. You have to fiddle with them a bit to get the brightness and contrast right, and the front viewing angle is limited to about 45 degrees on either side. The Western Digital video controller used in all four Rangers has 256K of video RAM and supports 32 colors or shades of gray at 640-by-480 resolution. The external video port supports up to 800-by-600 with 16 shades or colors, but the Rangers cannot display on both simultaneously.

The 82-key keyboards include 10 half-height function keys, 2 of which serve double-duty as the F11 and F12 keys when used with the Shift key. Of the 8 separate directional keys, the 4 cursor keys are in an inverted-T layout. An Fn

SUITABILITY TO TASK

	POOR	FAIR	GOOD	EXCELLENT
ALR Ranger M425s-120				
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger MC425s-120				
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger M425-120				
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger MC425-120				
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

ALR Ranger M425-120

List price (test configuration): $3,390.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: 4MB RAM upgrade, $279; 8MB RAM upgrade, $849; 16MB RAM upgrade, $1,699; external keyboard, $75; docking station, $695; extra battery, $175; adapter for Ethernet LANs, $199; SCSI interface module, $149; 2,400-bps data/9,600-bps send-only fax modem, $195; 9,600-bps fax modem, $345; nylon carrying case, $59.

ALR Ranger M425s-120

List price (test configuration): $2,890.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: M486DX/25 upgrade module, $699. Other options as above.

ALR Ranger MC425-120

List price (test configuration): $4,290.
Tested configuration: 4MB RAM, Toshiba MK212FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: As above.

ALR Ranger MC425s-120

List price (test configuration): $3,890.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, adapter for AC power.
Options: M486DX/25 upgrade module, $699. Other options as above.
In short: These machines offer excellent battery life and good performance. The size of the units is larger than average, however.

Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; 800-444-4257, 714-581-6770; fax, 714-581-9240

573 ON READER SERVICE CARD

The easy way.

Macintosh *is designed to make it easy to grow. Networking and sound support are already built in. File-sharing and multimedia capabilities are standard. So is support for up to seven peripherals. Which means you can add everything you see on the other page to this Macintosh IIvx without using up a single expansion slot. Leaving room for things like an accelerator card, an Ethernet or Token Ring card or other cards that allow you to customize a Mac for high-performance or specialized tasks*

cards and networking software. An Apple® Macintosh®, on the other hand, knows when you've added a hard drive. Installing a CD-ROM drive or scanner is a matter of plugging in a cable and clicking a couple of buttons. Even installing a network requires nothing more than plugging one Mac® into another. It's just one more example of how a Macintosh works in a simple, logical way. So you can, too.

If you know how to use a plug, you know how to expand a Macintosh.

This Macintosh IIvx has built-in monitor support for up to a 14" color monitor. Buy a card, and you can add a second monitor – significantly enlarging your desktop work area so you can move documents, files and folders across both screens.

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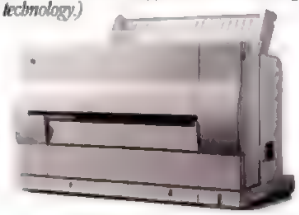
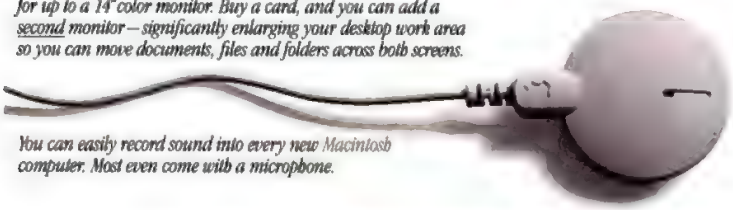


A Mac gives you professional-quality documents even if you're on a student budget. Just plug in an Apple StyleWriter® printer.



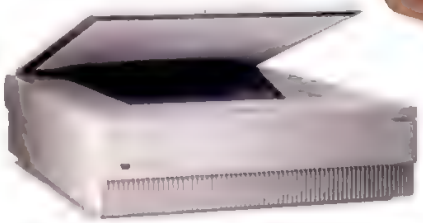
You can easily record sound into every new Macintosh computer. Most even come with a microphone.

Plug in an Apple Personal LaserWriter® NTR, and everyone in your workgroup will have access to the fastest printer in its class. (It works with PCs, too.)

Plug in a SyQuest drive, and you'll have virtually unlimited hard drive storage via removable 44MB or 88MB cartridges.

Plug in an Apple LaserWriter IIg, and everyone on your network will instantly be able to take advantage of the Apple PhotoGrade™ technology that rivals 800 dpi printers costing thousands more – for spectacular-looking documents.

Plug in an external hard drive or other storage device, and you increase your storage capacity in seconds.



Plug in an Apple OneScanner,™ and you can add beautiful black-and-white photographs to your documents with one touch of a button. No fussing or fiddling required.

Adding a peripheral to a Mac is as easy as using one. Plug it in, click a couple of buttons and get back to work.

For the second consecutive year, J.D. Power and Associates ranked Apple highest among Personal Computer Companies in Overall Customer Satisfaction.** And no wonder: whether you're writing a letter or adding a CD-ROM drive, only Macintosh makes things genuinely easy. Giving you the power you really want from a personal computer. The power to be your best.® Apple

*For the name of your nearest authorized Apple reseller, call 1-800-538-9696, ext. 230. In Canada, call 1-800-665-2775, ext. 910. **Invoice prices are based on industry averages. **J.D. Power and Associates® 1991 and 1992 Computer End User Satisfaction Studies. 1992 study conducted among 2,255 business end users at 1,145 business sites. ©1993 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, LaserWriter, Mac, Macintosh, StyleWriter and "The power to be your best" are registered trademarks of Apple Computer, Inc. AppleCD, OneScanner and PhotoGrade are trademarks of Apple Computer, Inc. Kodak and Photo CD are trademarks of Eastman Kodak Company. Windows is a trademark of Microsoft Corporation. SyQuest is a registered trademark of SyQuest Technology. This ad was created using Macintosh personal computers. L0366LL/A*

GRAPHICS APPLICATIONS

Hardware has finally matured to the point where the PC can be a true "graphics engine." This year's crop of software takes advantage of this new 24-bit graphics world.

WINNER

Fractal Design Painter for Windows, Version 1.2

Tom Hedges, Mark Zimmer

Fractal Painter is the ultimate computer simulation: It's a paint program that imitates the tools and media that traditional artists know and love. From its simulation of the bleeding of markers, the nubbiness of charcoal, the wash of a watercolor, and more, this 24-bit painting program is filled with innovations. It even works with pressure-sensitive tablets to let you mix colors and effects dynamically: You can draw red on blue and get purple, but you get darker purple wherever you press the tablet with more force.

The program also knows about drawing on different paper stocks: If you use the crayon to draw on "construction paper," you get the exact clumping effect that would result with a real crayon and paper because of the uneven fibers in the paper's texture. Fractal Design Painter for Windows, Version 1.2, bridges the gap between having to learn a whole new medium and drawing naturally with the aid of the computer.

▶*Fractal Design Corp., 335 Spreckels Dr., Aptos, CA 95003; 408-688-8800.*

FINALISTS

Aldus IntelliDraw 1.0

Mouhammad Fakhoury, Jonathon Gay, Roger Locke, Barry Owen, Cris Rys, Randy Silvia, Robert Tatsumi

Aldus combined everything it knew about mechanical drawing and drafting, usability, and presentation graphics to bring us a new kind of drawing program. In addition to some space-age-sounding tools called Symmetrigons and Connectigons, what makes IntelliDraw different is its approach to dimensioning.

In most programs, you can extend or contract a line or an object to change its dimensions. But in IntelliDraw, you can either change the line or change the value in a dimension line. When you change the value of the line, all objects that have been linked to the line change accordingly. This type parameter function was, until now, found only in CAD packages.

In a drawing package, "dimensioning" will make diagramming quick and easy. It's a great way to play "What If" with data ranging from organizational charts to office plans since a single change can rearrange an entire drawing.

▶*Aldus Corp., Aldus Consumer Division, 9770 Carroll Center Rd., Suite J, San Diego, CA 92126; 206-628-2320.*

Ofoto for Windows

Kenneth Carson, Rob Cook, Edward Granger, Eric Hermann, Robert Lay, Rocky Offner, Gary Poon, Jason Winshell

Grey-scale scanning is an art requiring knowledge of many things: resolution, bit depth, scale factors, gamma corrections, brightness, contrast, and threshold values. Until Ofoto, this was not a process for mere mortals. Ofoto takes these factors into account and optimizes each scan automatically. The software knows all sorts of printer devices, paper types, and printer inks and uses what it knows to calibrate accordingly. It can straighten skewed images and take you through the prescan, scan, resize, straighten, and crop phases with one button press. Ofoto puts professional-looking grey-scale scanning on autopilot.

▶*Light Source Inc., 17 East Sir Francis Drake Blvd., #100, Larkspur, CA 94939; 800-231-7226.*

After Hours

Thanks to rich user interfaces and innovative connections to the real world, after-hours computing has never been so engrossing—or so visual, or so musical, or so interactive.

WINNER

Knowledge Adventure Interactive Books

Steve Colwell, Fernando Echeverria, Bill Gross, Lee Hasiuk, Brad Haugaard, Dan Kegel

Possibly one of the noblest adventures in educational software, this series (Buzz Aldrin's Space Adventure, Isaac Asimov's Science Adventure, Knowledge Adventure, Sports Adventure) is information-packed. Children of all ages can navigate through interrelated topics, establishing connections between them. Knowledge Adventure, for example, navigates by timeline, topic, or map to let users wander through world science, history, art, literature, and music. Through high-tech compression technology, the series offers rich sound, video animations, and graphics without requiring a CD-ROM.
▶*Knowledge Adventure Inc., 4502 Dyer St., La Crescenta, CA 91214; 800-542-4240.*

FINALISTS

IntelliCharge in Quicken, Version 6.0

The IntelliCharge and Quicken Teams

Intuit's Quicken has always been a perennial favorite of ours. Now its IntelliCharge link spares users from manually entering credit-card statements. With Intuit's special VISA card, users can receive monthly statements by modem or disk and have credit-card purchases automatically appear in their personal records properly categorized. IntelliCharge makes keeping track of finances easy.
▶*Intuit, 155 Linfield Dr., Menlo Park, CA 94026; 800-624-8742.*

Midisoft Studio for Windows

Raymond Bily and the Studio for Windows Development Team

The perfect place for computers and music to meet is in Midisoft Studio for Windows, a program that was designed to let mainstream PC users compose and play music at near-professional levels.

The program combines real time sequencing with music notation, capturing notation from the keyboard (or fingerboard) and letting users record, edit, tweak, compose, arrange, and play along with MIDI sounds.

With features like Punch and Splice Cut/Paste, the program is rugged enough for true composers, but its clever graphical user interface guides amateur musicians through.
▶*Midisoft Corp., P.O. Box 1000, Bellevue, WA 98009; 206-881-7176.*

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"From a strictly price/performance point of view, no other machine can beat the...DTK"

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In PC Labs' disk performance tests, DTK's FEAT-3300 series finished second overall and ***first*** among those with non-cached drive controllers, completing the test ***an amazing 63% faster*** than our nearest competitor, IBM. And if it's cache control you want, look to DTK for caching IDE and SCSI controllers.

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And as a charter member of the Novell Labs Certification Alliance, DTK systems will fulfill your networking and interoperability needs. Our FEAT-3331 vertical model offers a full complement of 5 accessible 5.25" drive bays, plus a full height drive bay inside for your expansion needs. To put DTK's 486 CA$H controllers to work for you, call toll-free: ***1(800)BUY-A-DTK.***

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CIRCLE 102 ON READER SERVICE CARD

PERSON *of the* YEAR

MICHAEL S. DELL

Dell Computer Corp.

Nine years ago, 19-year-old University of Texas student Michael Dell bought out the surplus stock from local computer dealers. He added a few features, cut the retail price, and began advertising. The rest is history. Originally, these were sold as PC's Limited Brand Computers, and in the years since, many of Dell's initial sales ideas have become industry standards. By 1992, his way of doing business was being studied carefully by just about everyone trying to sell PCs.

Today, Dell's ideas probably don't sound too revolutionary because they've been so widely imitated. He was among the first to emphasize direct marketing to potential PC customers through mail-order ads. And what set the company apart in the early days were machines built to customer order and the then-unusual combination of national, next-day, on-site service and toll-free technical support. The company later began making its own research and development investments. Dell was also an early proponent of catalog sales and computer superstores. This past year year, even IBM, Compaq, and Apple began introducing lower-cost lines. Dell Computer was the model.

Many have benefited from Dell's strategies. While Dell Computer's sales grew to over $1 billion, an entire industry found a new way of selling and distributing computers. More important, Dell was able to offer customized machines at good prices, with good components. Dell's impetus helped lead to the tremendous competition witnessed in the PC market in 1992, a trend we expect will continue.

LIFETIME ACHIEVEMENT

RAYMOND J. NOORDA

Novell

While other companies emphasized competition and developing their own products, Novell chairman and president Raymond J. (Ray) Noorda took his down a different path.

Noorda joined Novell in 1983 and transformed a company that was an unsuccessful maker of PC hardware into the leading proponent of networking systems in the industry. Despite continuing competition, NetWare has been the leading network operating system for many years, and today it has a commanding market share. At the same time, Noorda has pushed NetWare toward adopting more sophisticated technology, such as System Fault Tolerance and NetWare Loadable Modules.

What made NetWare, and Novell, successful is Noorda's emphasis on what he calls "co-opetition," which means cooperating with competitors to make sure that networking works well for customers. While Microsoft's operating systems compete with Novell, Noorda's company made sure that Microsoft Windows and NetWare work well together. While IBM sells competitive products such as LAN Server, Novell made IBM a NetWare reseller. Novell also became a partner with UNIX Systems Laboratories, distributing UnixWare on the PC through its Univel joint venture.

That willingness to work with competitors has distinguished Novell since Noorda joined the company. From network cards to disk controllers to a growing emphasis on the operating system, Noorda was pivotal in shaping the infrastructure that made NetWare so successful. He indeed brought networking into the mainstream of personal computing.

Photographs by Steven Pumphrey (top), David Strick/Onyx

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AWARDS FOR TECHNICAL EXCELLENCE: PREVIOUS WINNERS

1991

WINNER	COMPANY	CATEGORY
Altair Wireless Ethernet	Motorola Inc.	Connectivity
Daniel Bricklin and Robert Frankston	Slate Corp.	Lifetime Achievement
Philip D. (Don) Estridge	IBM Corp.	Person of the PC Decade
FoxPro, Version 2.0	Fox Software Inc.	Applications Software
IBM LaserPrinter 10	Lexmark International Inc.	Printers
Philippe Kahn	Borland International Inc.	Person of the Year
Microsoft Visual Basic	Microsoft Corp.	Development Tools
PenPoint	GO Corp.	Standards and Operating Systems
SimEarth	Maxis	After Hours
Stacker, Version 1.1	Stac Electronics	Utilities
Toshiba T2200SX	Toshiba America Information Systems	Portable Computers

1990

WINNER	COMPANY	CATEGORY
Compaq Systempro	Compaq Computer Corp.	PCs
Compton's MultiMedia Encyclopedia	Britannica Software Inc.	Entertainment/ After Hours
Finis Conner	Conner Peripherals	Persons of the Year
Developer's RenderMan	Pixar	Software
Edsun Continuous Edge Graphics	Edsun Laboratories Inc.	Emerging Technology
Adele Goldberg	Xerox's Palo Alto Research Center	Lifetime Achievement
HP LaserJet III	Hewlett-Packard Co.	Hardware
HP NewWave, Version 3.0	Hewlett-Packard Co.	Operating Environments
Terry Johnson	PrairieTek	Persons of the Year
LANtastic Voice Adapter	Artisoft Inc.	Connectivity
Sharp PC-6220	Sharp Electronics Corp.	Portables
Texas Instruments TravelMate 2000	Texas Instruments	Portables
Turbo C++ Professional	Borland International Inc.	Development Tools
Xircom Pocket LAN Adapter	Xircom Inc.	Design

1989

WINNER	COMPANY	CATEGORY
Audio Visual Connection	IBM Corp.	Hardware
Autodesk Animator	Autodesk Inc.	Graphics
Joseph R. Canion	Compaq Corp.	Person of the Year
IBM LaserPrinter	IBM Corp.	Printers
Lotus Magellan	Lotus Development Corp.	Utilities
MultiScope OS/2 Debugger	Logitech Inc.	Development Tools
NetWare 386, Version 3.0	Novell Inc.	Connectivity
OS/2, Version 1.2	IBM Corp., Microsoft Corp.	Operating Environments
The Poqet PC	Poqet Computer Corp.	Portables
Quattro Pro	Borland International Inc.	Applications
Roland LAPC-I	Roland Corp. US	Entertainment/ After Hours
John Warnock	Adobe Systems Inc.	Lifetime Achievement

1988

WINNER	COMPANY	CATEGORY
All Chargecard	All Computers	Add-in Boards
ALR FlexCache 25386	Advanced Logic Research Inc.	Desktop Machines
Intel 80386 Design Team	Intel Corp.	Persons of the Year
Kurta IS/ONE Cordless Stylus/Puck	Kurta Corp.	Hardware
Lahey Fortran 286 and 386	Lahey Computer Systems Inc.	Compilers/ Languages
Micrografx Designer	Micrografx Inc.	Graphics Software
Microsoft Mouse	Microsoft Corp.	Design
NEC UltraLite	NEC Home Electronics (U.S.A.) Inc.	Portables
Q&A, Version 3.0	Symantec Corp.	Application Software
Dennis Ritchie	AT&T Bell Laboratories	Lifetime Achievement
SunRiver Workstation	SunRiver Corp.	Connectivity
Turbo Debugger	Borland International Inc.	Development Tools
VM/386	Intelligent Graphics Corp.	386 Software Technology

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CIRCLE 056 ON READER SERVICE CARD

AWARDS FOR TECHNICAL EXCELLENCE: PREVIOUS WINNERS (CONTINUED)

1987

WINNER	COMPANY	CATEGORY
AutoShade	Autodesk Inc.	Graphics Software
Compaq Deskpro 386/20	Compaq Computer Corp.	Desktop Computers
Compaq Portable 386	Compaq Computer Corp.	Portable Computers
Douglas Engelbart	McDonnell Douglas Information Systems Group	Lifetime Achievement
LIM expanded memory specification 4.0	Lotus Development Corp., Intel Corp., Microsoft Corp.	Utilities
Lucid 3D	Personal Computer Support Group	Application Software
Micro Channel architecture	IBM Corp.	Special Category
Microsoft Excel for Windows	Microsoft Corp.	Application Software
Microsoft Windows/386	Microsoft Corp.	Operating Environments
Publisher's Type Foundry	ZSoft Corp.	Desktop Publishing
QuickBASIC, Version 4.0	Microsoft Corp.	Development Tools
3Com 10Mb Twisted Pair	3Com Corp.	Connectivity
Turbo Pascal, Version 4.0	Borland International Inc.	Development Tools
Zenith Perfect Monitor, Model ZCM-1490	Zenith Data Systems	Hardware

1986

WINNER	COMPANY	CATEGORY
Advanced NetWare/286	Novell Inc.	Networking
Compaq Deskpro 386	Compaq Computer Corp.	Desktop Computers
Bill Gates	Microsoft Corp.	Special Award
Lotus HAL	Lotus Development Corp.	Software Add-ons
Microsoft Windows, Version 1.03	Microsoft Corp.	Environments
NEC MultiSync	NEC Home Electronics (U.S.A.) Inc.	Graphics Hardware
NewViews	Q.W. Page Associates Inc.	Application Software
Perspective	Three D Graphics	Graphics Software
QuickBASIC 2	Microsoft Corp.	Programming Languages
TIPS	Island Graphics Corp.	Graphics Software
Toshiba T3100	Toshiba America Information Systems Inc.	Portable Computers
What's Best!	General Optimization Inc.	Software Add-ons
Zenith Z-181 Portable PC	Zenith Data Systems	Portable Computers

1985

WINNER	COMPANY	CATEGORY
Apple LaserWriter	Apple Computer Inc.	N/A
Mike Brown	Central Point Software	Special Award
EGA CHIPSet	Chips and Technologies Inc.	N/A
Freelance	Lotus Development Corp.	N/A
IBM Proprinter	IBM Corp.	N/A
Javelin	Javelin Software Corp.	N/A
LANLink	The Software Link	N/A
Plus Hardcard	Plus Development Corp.	N/A
Trailblazer modem	Telebit Corp.	N/A

1984

WINNER	COMPANY	CATEGORY
Enable	The Software Group	N/A
Framework	Ashton-Tate Corp.	N/A
Infoscope	Microstuf	N/A
Intel 80286	Intel Corp.	N/A
PC Blue Series	(Public domain)	N/A
Turbo Pascal	Borland International Inc.	N/A

N/A—Not applicable: Winners were not designated by category in 1984 and 1985.

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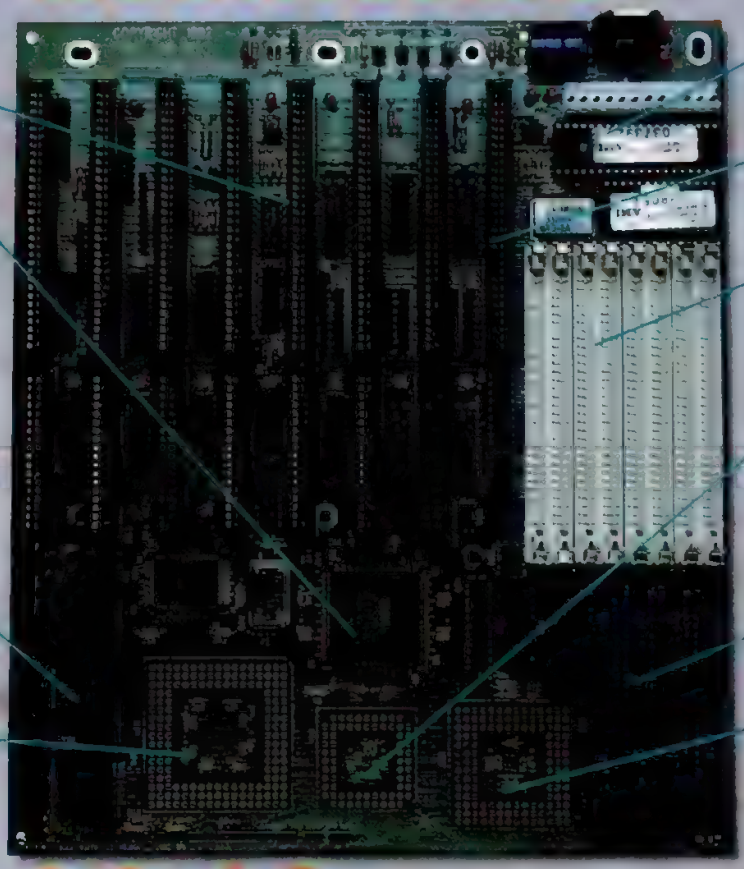
CPUs/ACIO

Intel
486DX 50MHz
486DX 33MHz
486DX2 66MHz
486DX2 50MHz
486SX 25MHz



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CIRCLE 194 ON READER SERVICE CARD

THE COMPAQ PROSIGNIA PC S
THE SAME IMPACT AS OUR R

Not long ago, we introduced PCs that established us as the new leader in affordable computing. To that we now add the COMPAQ ProSignia Family of PC Servers: delivering a new level of performance, affordability and support by establishing a new class of PC servers.

Ironically, the more critical your PC network becomes, the more likely your network server will prove inadequate.

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PROCESSORS: *chip upgradable 486/33 or 486DX2/66* **EXPANSION:** *7 32-Bit EISA bus master slots* **STORAGE:** *over 6GB internal in 8 bays* **HARD DRIVES:** *Fast-SCSI-2 (330MB, 550MB, 1.05GB), Drive Array Pairs (680MB, 1.02GB), IDE (210MB, 340MB, 510MB)* **DRIVE CONTROLLER:** *Integrated or optional 32-Bit Fast-SCSI-2, IDA-2, or Integrated IDE (on models 1/EL and 340/W)* **NETWORK CONTROLLER:** *Preinstalled 32-Bit NetFlex Controller* **SERVER MANAGEMENT:** *INSIGHT Server Management Framework* **RAM:** *4-128MB of industry-standard SIMMS* **WARRANTY:** *Free three-year, parts and labor, on-site** warranty* **SUPPORT:** *Free 24-hour, 7-day hardware support, optional multi-vendor network operating system support.*

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COMPAQ ProSignia disk-configured models come standard with an all-new 32-Bit Fast-SCSI-2 Controller that performs twice as fast as old SCSI technology. As well as a preinstalled, COMPAQ 32-Bit NetFlex Controller that works with Ethernet or Token Ring. And for those who require truly

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To learn how easy it is to get up and running, just call 1-800-345-1518 in the U.S., or 1-800-263-5868 in Canada.

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The COMPAQ ProSignia starts at under $2,700† and is designed, tested and certified to run NetWare flawlessly. We even offer NetWare from Compaq to optimize server management capabilities.

intel inside

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PORTABLE COMPUTERS

On the Road

In just four months, the portable PC market has almost completely turned its products over. As an indication of how quickly change occurs in this area, in August *PC Magazine* devoted a single issue to reviewing all the new notebook PCs—80 of them. In this story, we take a look at 64 color and monochrome systems released since then and re-review 3 machines from our last portable PCs roundup for comparison.

The laptop buyer is the ultimate beneficiary of the rapid change, with greater performance, more features, and lower prices across the board. For instance, with the exception of eight machines, all systems are based on at least a 25-MHz 386 processor. Many systems now include built-in trackballs of varying quality, and an increasing number have 120MB hard disks available. Weight and size have decreased marginally, and battery life is improving, although we expect the biggest gains to come next year when systems built around the 3.3-volt 486SL processors

Slim, light, and powerful are the qualities that traveling executives cherish most in a portable computer. *PC Magazine* tests 67 of the latest portable systems ranging from Acer to Zenith.

by Bill Howard

Photograph by Mark Weiss

IN THIS REVIEW

Performance Tests 177
Summary of Features 200
AcerAnyWare V386SL 159
ALR Ranger M425-120 162
ALR Ranger M425s-120 162
ALR Ranger MC425-120 162
ALR Ranger MC425s-120 162
Altima 325 80386SL 172
Altima 433 80486DX 172
American Mitac 3025F 189
American Mitac 3027F 189
Amrel MLT486DXU33 189
Aspen Aquiline 433 198
Austin 386/SXL-25 Notebook 199
AVI ANB3-386SXL-25 199
BLK 386SL/25NBF 215
Chaplet 386 SL25 Notebook 215
Compaq Contura 3/20 216
Compaq Contura 3/25 216
Compaq LTE Lite/25E 217
CompuAdd Express 425CXL-80 217
Compudyne Slimnote 386SL/25-80 172
Compudyne Slimnote 486SX/25-80 172
Digital DECpc 325p 222
Dell Dimension NL20 218
Dell System 320SLi 219
Dell System 325N 222
DTK Grafika 3N 225
Ergo 486DX-33 NoteBrick II 198
Everex Carrier SL/25 226
GRiD 1660 222
GRiD 1755 486SLC 222
GRiD Convertible 226
IBM PS/note N45sl 229
Identity 386SXL-25 Notebook Computer 230
Jetta Jetbook 486DX/33 230
Keynote 386SX-25 237
Keynote 486SLC 237
Leading Edge N3/SL25 Plus 238
Librex R386SL 240
Librex T386SX 238
Lightning Thundernote 486DX/33 172
Matrix 486SX-25Mhz Notebook 240
Micro Express NB486DX 244
Micro Express NP933 244
Mitsuba Ninja 486SX 240
PC&C Dynova SLic3000 246
Poly NB325T 246
Poly NBC25 248
Primax Eagle 425SX 248
Primax Nighthawk 325SXL 250
QSI Klonimus Lite 386SL/25 250
Samsung NoteMaster 386L/25 256
Tandy 3800 HD 258
TI TravelMate 4000 WinDX/25 258
TI TravelMate 4000 WinSX/25 258
Toshiba Satellite T1800 259
Toshiba T3300SL 260
Twinhead Slimnote 486DX/33 172
Wyse DecisionMate 486SLC 261
ZDS Z-Note 320L 263
ZDS Z-Note 320Lb 263
ZDS Z-Note 325L 263
ZDS Z-Sport 325S 264

become prevalent.

Video performance remains the stumbling block, with both speed and quality lagging far behind recent strides in desktop PCs.

ACTIVE-MATRIX MONOCHROME LCD

The hottest new machine is the Compaq LTE Lite/25E, which seeks to take the best of both worlds: the extended battery life of a monochrome system with the brilliant clarity of an active-matrix display. Its display quality is head and shoulders above that of every other noncolor system reviewed here or in any previous issue. The Lite/25E is one notebook that several people can gather around, and all can get a good view, regardless of viewing angle. An earlier generation of the display was used on Apple's PowerBook, though the Compaq screen is sharper.

Once you've seen the Lite/25E's display, you're likely to decide that running Microsoft Windows on any other noncolor portable system is a compromise. We awarded the Lite/25E one of our Editors' Choice designations for this story. But before you sign on with Compaq, try the keyboard, which many *PC Magazine* testers found to be stiff.

Other intriguing systems under review include

- the sub-4-pound Dell System 320SLi, a subnotebook with an external floppy disk drive and no screen illumination;
- the GRiD Convertible, a notebook/tablet hybrid that combines a rudimentary stylus with a standard keyboard, and
- ZDS's Z-Note family, which comes with built-in Ethernet LAN connections and shells of popular network programs.

Equally intriguing is the impending demise of Librex at a time when lesser-known vendors have narrowed the quality and performance gap between the haves (such as Compaq, Toshiba, and ZDS) and the have-lesses. The Librex R386SL impressed us with consistent high quality and technical advances like its reversible, clip-on trackball for both left- and right-handers. Despite a huge image advertising campaign, Librex couldn't garner enough market share to satisfy its parent, multi-billion-dollar Nippon Steel, which will pull the plug by April. If there's a lesson from the Librex departure, it's that even though laptops are the fastest growing area of the PC business, there are still too many brands chasing a finite number of buyers.

WINDOWS NONPERFORMERS

The more we run Microsoft Windows on the road with notebook systems, the more disenchanted we become. Virtually all monochrome LCD screens have trouble resolving colors as clearly distinguishable shades of gray. Also, we have grown tired of bulky clip-on trackballs and the always available, however inconvenient, built-in mini-trackballs. Yes, you can run Windows, but it's not pretty, it's not convenient, and it's not very fast. Products such as the Compaq LTE Lite/25E and the color systems in this review represent what we believe will soon be the preferred display quality for Windows systems.

The most disappointing aspect of working with a notebook is the lackadaisical video performance under Windows. At a time when desktop systems commonly achieve a Graphics Winmark score of 5 to 8 megapixels per second and the best machines go beyond 12, the 60 monochrome notebooks we reviewed averaged only about 1.7 megapixels per second. Video performance generally

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tracked processor type. All but 1 of the 22 machines with 486 chips from Intel and Cyrix produced a Graphics Winmark score of at least 2 megapixels per second, just ahead of the machines with Intel 386SX, SL, and AMD SXL chips, at less than 2. The fastest performer was the Intel 486SX/25–based TI TravelMate 4000 WinSX/25, with a Graphics Winmark score of 2.9, followed by Jetta International's Jetta Jetbook 486DX/33 at 2.8.

BATTERY LIFE IMPROVING

We consider how long a system can operate on the road without needing an AC outlet to be of paramount importance. As a result, we test notebook battery life in two ways: with our Battery Rundown test, a worst-case scenario rundown with power conservation disabled, and our ZDigit Rundown test, during which power conservation is enabled and the system alternates between 2 minutes of enforced activity and 10 minutes of inactivity. Based on our informal threshold of a 3-hour battery life, ten systems met that standard on the worst-case rundown. Seven of those managed even better, achieving either 3.5 hours on the Battery Rundown test or 5 hours on the ZDigit test: the Dell System 320SLi, the Dell System 325N, the Librex R386SL (with its add-on battery installed), the TI TravelMate 4000 WinSX/25, the Toshiba T3300SL, the Z-Note 320L, and the Z-Note 325L. At the other extreme, the GRiD Convertible only lasted 1 hour 39 minutes before needing a charge on our ZDigit test.

As always, our curiosity was aroused by those systems that were announced but didn't ship in time for testing, particularly portables based on Intel's 486SL chip. Designed to run at either 3.3 or 5 volts, the 486SL, unlike the 486SX seen on nine systems reviewed here, includes a built-in math coprocessor. Intel says the 486SL has twice as much power (exclusive of the math unit) as the 386SL and will produce 25- and 33-MHz versions, positioning it as a truly high-end notebook chip. The first 486SL systems are expected to ship by late fall, led by the 25-MHz 6.5-pound Compaq active-matrix color LCD unit with a 209MB hard disk and a 14,400-bit-per-second data/fax cellular modem option.

Look for 160MB to 210MB 2.5-inch hard disks to be available in limited quantities by early 1993. Price? About $300 to $500 more than a 120MB hard disk. Taking a different tack, Identity Systems Technology has announced that in November they will offer a 500MB hard disk option using a bulkier—and heavier—3.5-inch drive. AST Research's new PowerExec 3/25SL features 60MB to 160MB hard disks that can be plugged into desktop PCs with a $99 drive bay adapter.

In an effort to shed weight and add versatility, some new notebooks will allow you to slide out the floppy disk drive and reduce travel weight by just under a pound, and/or to slide in a second battery in place of the floppy disk drive. On its new CF-1000, based on the 3.3-volt AMD 25-MHz SXLV processor, Panasonic claims up to 11 hours of stop-and-go use with both batteries installed.

Also by early 1993, users with laptops containing credit card–size PCMCIA slots may finally see some relief from low-speed modems. AT&T announced the shipment of a 14,400-bps PCMCIA data/fax modem that will be built by AT&T and sold by others. Other PCMCIA cards recently announced include wireless LAN cards from Proxim, which allow radio frequency communications with an effective range of several hundred feet at roughly floppy disk transfer speeds, and virtually indestructible flash memory cards from SunDisk.

On the color front, IBM showed a ThinkPad 700c, the first fruits of its joint venture with Toshiba on active-matrix LCD screens. *PC Magazine* examined a

HIGHLIGHTS

Monochrome Notebook PCs

COMPAQ'S LTE LITE/25E, with the world's first production active-matrix PC monochrome screen, was easily able to eclipse the displays of every other portable in the test. Not only can it realistically reproduce colors as shades of gray, its display can be viewed from a variety of angles, making it perfect for small group presentations.

BATTERY LIFE continues to improve. With power-conservation features enabled, 43 machines lasted for more than 3 hours on our ZDigit Rundown test. In contrast, the GRiD convertible could operate for only 1 hour 39 minutes on a charge.

THE GRiD CONVERTIBLE notebook incorporates a rudimentary stylus that can be used for pointing or drawing with a standard keyboard, but a current lack of applications software reduces its usefulness. Most intriguing is its ability to let users sketch with the pen in space above the screen.

BUILT-IN TRACKBALLS were generally disappointing. Included with many of the units tested, most were in awkward spots, required two hands to operate, and often were too inaccurate to be effective.

WINDOWS PERFORMANCE for most of these notebooks also was a letdown. The best portables were able to acheive a Graphics Winmark score one-third that of the average desktop unit. With the exception of the Compaq LTE Lite/25E, none were able to mimic the colors in Windows as various shades of gray.

TODAY'S IDEAL NOTEBOOK is powered by at least a 25-MHz 386 processor, has a hard disk in the 80MB to 120MB range, and can operate for at least 3 hours without visiting an AC outlet for recharging.

ZENITH'S Z-NOTES came with built-in LAN Ethernet connections, the only portables to include this important device.

THE DELL 320SLi trades screen illumination and a built-in floppy disk drive for a lightweight (3.8 pounds), easily transportable package. It is a passable compromise for those who need to avoid the bulk of today's standard-size notebooks.

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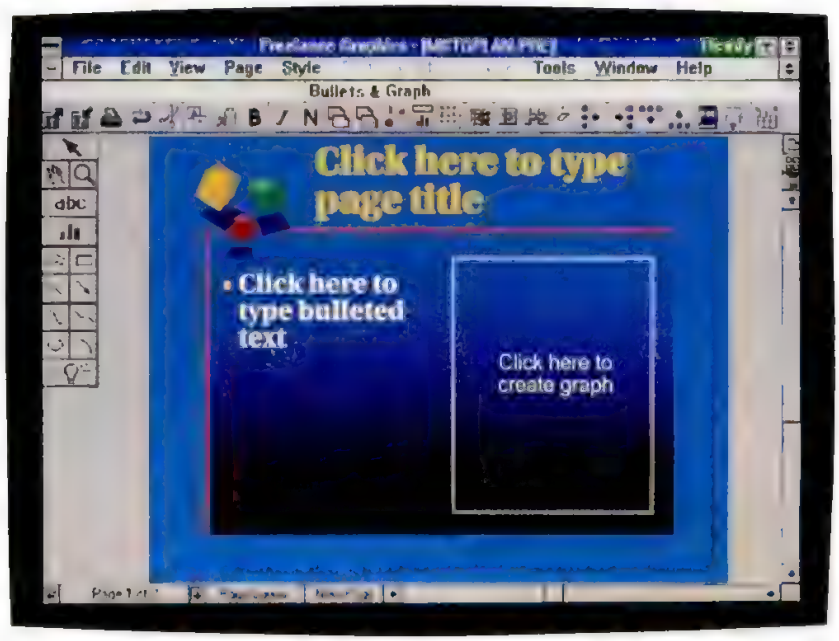

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What's more, a recent study conducted by the Usability Sciences Corporation found

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Or better evidence to prove it.

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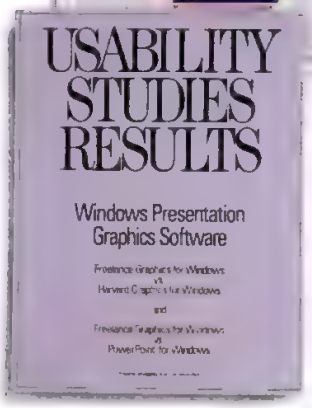

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near–production-level unit and found the 10.5-inch display to be nothing short of dazzling.

While in the past we've been skeptical of passive-matrix color technology's often muted appearance, which is reminiscent of an Impressionist painting, that appraisal was based primarily on economics. And, as the price premium of passive-color over monochrome falls to $500, we believe it may be time to take a second look.

So far, few vendors have chosen to follow the subnotebook path taken by Dell with its 320SLi. Dell squeezed what would have been a 5.5-pound notebook PC down to 3.8 pounds by removing the floppy disk drive (it's an external plug-in) and removing the screen's backlighting. It's still an open question whether *any* display that relies on reflection will satisfy users.

REVIEW CRITERIA

To be included in this review, products had to be battery-powered notebooks with least a 20-MHz 386SX, 386SL, or equivalent AMD or Cyrix processor; AMD and Cyrix processors powered 12 systems in our roundup. Monochrome systems had to weigh less than 7 pounds with batteries or have a road weight (including AC adapter) of less than 9 pounds. We tested only new systems that were shipping by early fall; prices are current as of late October. We re-reviewed two monochrome Editors' Choice systems, the Dell System 325N and the Toshiba T3300SL, for comparison.

In addition to the tested products, we learned of several notebook systems that were announced but not shipping as of our deadline, including the Aspen 486 Personal Notebook, the AST PowerExec 3/25SL, a new line of Innova notebooks from Canon, the pen-based NCR 3-30 Notepad, PC Brand's LeaderBook 486/SLC, the Zeos Freestyle SL, and IBM's monochrome pen-based ThinkPad.

In addition, several systems submitted by vendors turned out to be less than meets the eye and were dropped from this review. Some were discontinued, including ACMA's 386DX/33, Blackship's BLK 386SXNB, Bona International's Bonafide 3800 SXL/25 and 3900 SL/25, and PC Brand's 486/SLC Notebook. Others were judged to be prototype machines or encountered unresolvable problems during testing, including the Compudyne SlimNote 486DX2/50 and Spear Technology's NP206. Several vendors, including CompuAdd Express, Cumulus, and Swan, decided not to participate in this review.

SUITABILITY TO TASK

To help select the system that's right for you, we evaluate each system for its suitability for use in four areas: on-the-road computing and communications, DOS applications, Windows applications, and as a desktop replacement.

After our first Suitability to Task ratings (August 1992), some readers and vendors complained that we aimed too high by setting the top score at what we believe users expect from a good product. For instance, not many products have 9,600-bps or faster modems built-in, but we believe it's reasonable to expect this level of performance in portable computers. By early 1993, the market should catch up with our expectations.

PC MAGAZINE ▶ EDITORS' CHOICE

• Compaq LTE Lite/25E

If you are as demanding as we were while testing these 60 monochrome portable computers, you would probably be happy with any of at least half of them. But the products of three vendors stand apart from the crowd: Compaq, Dell, and Toshiba. They continue to leapfrog the competition and to play leapfrog with each other's 25-MHz Intel 386SL-based notebook systems in terms of price, performance, and features. Among the monochrome systems reviewed twice before this year, those three vendors accounted for all five Editors' Choice selections. In this issue, it's Compaq's just-released LTE Lite/25E that receives an Editors' Choice award. The Dell System 325N and the Toshiba T3300SL, Editors' Choice selections in our August 1992 roundup of portables, merit honorable mention this time around.

Compaq's stunning active-matrix monochrome display makes the 6.5-pound Lite/25E a one-of-a-kind portable—at least for now. It's the only noncolor portable PC system with an active-matrix display and the only noncolor notebook system that adequately renders the colors in Microsoft Windows and graphics-intensive applications as clearly distinct shades of gray. We were impressed by the screen's consistently superior image quality, its high contrast ratio, and its ability to accurately display black and white. One staffer remarked that the display resembled a black-and-white television screen. We expect other portable PC makers to have similar products in the near future.

Compaq's communications option is equally state-of-the-art: an optional 14,400-bit-per-second (V.32bis) data/9,600-bps send-fax modem with the ability to use standard and cellular telephones. Other features that give the Compaq the best combination of performance and features: a QuickConnect port replicator similar to ZDS's; multiple levels of keyboard, screen, and drive security; and the ability to write the contents of memory to disk. Equally impressive was the Compaq's lightweight batteries, which lasted 2 hours 38 minutes on our Battery Rundown test and 4 hours 11 minutes on our ZDigit Rundown test (with conservation features enabled)—about 20 and 40 minutes above average, respectively.

Our only qualm, and this pertains to all Compaq LTE Lite systems, involves the keyboard: The feel is quite stiff and key travel is limited, both of which may not be to your liking, and

the directional keys are a bit small. With a $2,999 list price that buys you 4MB of RAM and an 80MB hard disk, the 6.5-pound Lite/25E is a fair deal.

HONORABLE MENTION

Dell Computer Corp.'s Dell System 325N and Toshiba America Information Systems' Toshiba T3300SL have each come down in price since winning Editors' Choice recognition in August. The Dell's price has dropped by about $400 and the Toshiba's more recently by about $1,000. But despite attractive price tags, neither have Compaq's display.

The Dell represents a highly affordable value at $2,249 for 60MB, with an excellent battery life (3 hours 41 minutes and 5 hours 7 minutes on the Battery Rundown test and ZDigit Rundown test, respectively), and a 9,600-bps data and fax modem option. Keyboard feel is good, but the key width was reduced slightly to make the case 11 by 8.5 inches.

If you want the best keyboard among portables, look no further than Toshiba's T3300SL, list-priced at $2,798 with 4MB of RAM and a 120MB hard disk. Its battery life is great (it scored 3 hours 19 minutes on the Battery Rundown test and 5 hours 8 minutes on the ZDigit Rundown test), and the AC adapter is a model of space efficiency. Toshiba's Achilles' heel: its reliance on a PCMCIA slot for modem communications, a problem until 9,600- and 14,400-bps data modems become available early in 1993.

IN THIS ISSUE

Reviews in this issue are arranged in two sections: 60 monochrome portable PCs and 7 color portable systems. Because of their similarity, the two color machines from ALR are reviewed with their monochrome relatives and have entries in the monochrome portables Summary of Features table and benchmark test pages. All systems sharing the same FCCB ID number are reviewed together (although tests were run separately on each system). In this issue, we encountered several machines of common manufacture: the fraternal twins include products from Advanced Logic Research, Altima Systems, Aspen Computer, Compudyne Products, Digital Equipment Corp., Ergo Computing, GRiD Systems Corp., Lightning Computers, Matrix Digital Products, Mitsuba Corp., and Twinhead Corp. Within the categories, they're generally in alphabetical order by vendor name, from Acer America Corp. to Zenith Data Systems. Products from a single OEM are grouped together, as are products in the same line from a single vendor.

Acer America Corp.

AcerAnyWare V386SL

The $1,999 AcerAnyWare V386SL is a lightweight 386SL/25 notebook that combines comprehensive power-management features and adequate performance in a lightweight package.

The 7.2-pound road weight (with a battery, power cord, and 1-pound AC adapter) is lighter than average for this test. Our 2- by 11.4- by 8.5-inch test unit had 4MB of RAM (12MB is the maximum); a 81MB Seagate hard disk; one parallel, two serial, and a combination mouse/external keyboard modem port; a VGA monitor connector; and a PCMCIA Type II slot that accepts any PCMCIA V.42 or V.32bis fax modem.

The AcerAnyWare can't charge while

FACT FILE

AcerAnyWare V386SL

Acer America Corp., 2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237, 408-432-6200; fax, 408-432-6221

List price (tested configuration): $1,999

Tested configuration: 4MB RAM, 81MB Seagate ST9096 hard disk, DOS 5.0A, Microsoft Windows 3.1, 1.44MB floppy disk drive, Logitech trackball

Options: 2MB RAM upgrade, $179; 4MB RAM upgrade, $359; 120MB hard disk, $200; docking station, $699, , V.32 modem, $299, V.32bis, $499 (both PCMCIA 4,800-bps receive-only/9,600-bps send-only fax)

In short: This computer performed respectably on our tests. Its power-management features are necessary because it can't recharge while in use.

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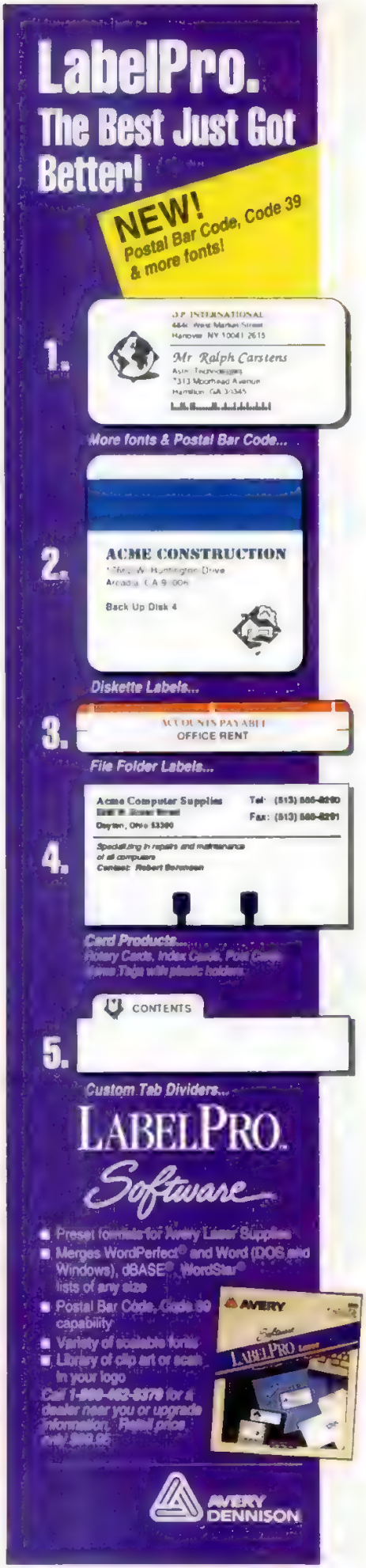

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Suitability to Task: Monochrome Portables

Five of the monochrome systems we reviewed—the TI TravelMate 4000 WinSX/25 and WinDX/25, Polywell's Poly NBC25, the Jetta Jetbook 486DX/33, and the Compudyne Slimnote 486SX/25-80—notably combined the light weight, long battery life, and high-speed communications devices required to be good traveling companions.

Most units fell short in several categories. Only the Compaq LTE Lite/25E, with its revolutionary active-matrix monochrome LCD screen, could accurately display the colors used in Microsoft Windows as realistic shades of gray. And only three of the monochrome notebooks—the Altima 433 80486DX, the Compudyne Slimnote 486SX/25-80, and the Twinhead Slimnote 486DX/33—were considered suitable for use as desktop replacements.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Road warrior/communications indicates how complete a traveling companion each portable is. A unit was rated as ***excellent*** if it combined in a small package light travel weight (no more than 7 pounds, including AC adapter and battery), long battery life (at least 3 hours with power-conservation features enabled), and good communication options (such as a 9,600-bps data/fax modem or a PCMCIA card).

DOS applications measures each system's ability to run DOS software quickly. To rate ***excellent*** in this category, a system must have at least a 25-MHz 386 processor, as well as an 80MB hard disk or larger, a display that measures at least 9 inches diagonally, and a DOSmark score in the top 25 percent on PC Magazine Labs' Hardware Benchmark Tests, Release 7.0.

Windows applications are extremely demanding, requiring a combination of processor speed and high-volume data storage. To be worthy of a top rating in this area, a unit should have system memory that can be expanded to at least 8MB, a 120MB hard disk available, Graphics Winmark and Disk Winmark scores in the top 25 percent, a built-in pointing device, and power management that works under Windows. Image quality was also a criterion.

To be considered a suitable **desktop replacement**, a system has to be capable of internal expansion or have a docking station available, offer a 120MB hard disk or larger, and support Super VGA graphics on an external monitor. We also consider the portable's keyboard and whether an external keyboard can be plugged in.

operating, but the company claims that its nickel cadmium battery pack can be fully recharged in 2 hours and lasts for up to 4.5 hours of use. On our tests, the battery lasted only 1 hour 56 minutes with power conservation turned off (user-adjustable display, hard disk, and system timeouts, along with a standby button and a CPU power-down preset to 3 minutes); with power conservation, it managed 3 hours 2 minutes in ZDigit testing.

SUITABILITY TO TASK

AcerAnyWare V386SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

This portable's Sharp screen is capable of VGA resolution with 32 shades of gray, and it can simultaneously support an external Super VGA monitor at 16 colors.

The edgelit TSTN (triple-supertwist nematic) panel is slightly dark under DOS but brightens under Windows. Acer's 82-key keyboard has 12 half-height function keys and separate PgUp, PgDn, Home, and End keys; cursor keys, in an inverted-T layout, are too close to Home and End.

The AcerAnyWare produced an above-average DOS video score but a poor Graphics Winmark result. The portable's memory and processor scores were average, and its disk scores were well above the average.

The AcerAnyWare V386SL

The company includes a one-year parts-and-labor warranty, along with a 24-hour replacement policy for the first year.—*Robin B. Bornstein*

Advanced Logic Research Inc.

ALR Ranger M425s-120
ALR Ranger MC425-120
ALR Ranger M425-120
ALR Ranger MC425s-120

There are two choices to make when it comes to Advanced Logic Research's notebooks: 486SX or 486DX, and color or monochrome. ALR's Ranger series have easy CPU upgradability and a large array of internal options, but they are heavier than average.

The four Rangers were equipped identically except for their processors and screen technologies. Each computer came with 4MB of RAM and a 120MB Toshiba hard disk. Of the two 486SX/25 models, the $2,890 ALR Ranger M425s-120 has a passive-matrix monochrome screen, and the $3,890 ALR Ranger MC425s-120 comes with a passive-matrix color screen. The higher-powered ALR systems each had a 486DX/25 CPUs and passive-matrix screens: The monochrome ALR Ranger M425-120 costs $3,390, and the color ALR Ranger MC425-120 costs $4,290.

If you want to save money initially, buy one of the 486SXs and then upgrade to a 486DX. (The color and monochrome 486SXs cost $400 and $500 less than their 486DX versions, respectively.) Upgrad-

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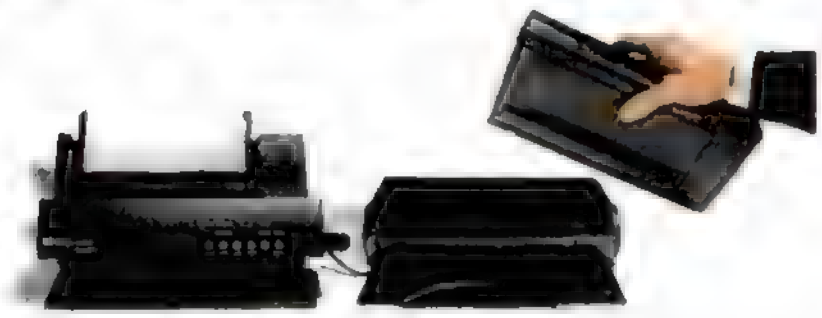

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HEWLETT PACKARD

Price/Performance Index: *Monochrome Portables*

Roughly one-quarter of the 60 monochrome portable PCs we tested for this issue—16 of them—featured Intel 486 microprocessors, and as might be expected, those units dominated the high-performance area of our price/performance chart. The TI TravelMate 4000 WinDX/25 and WinSX/25, along with the Aspen Aquiline 433, were performance leaders and fell in the upper price range. The leading price/performers in the 486 class were the Lightning Thundernote 486DX/33, the Compudyne Slimnote 486SX/25-80, and the Primax Eagle 425SX.

Five systems used the Cyrix 486SLC/25 chip. The CompuAdd Express 425CXL-80 and Keydata's Keynote 486SLC scored respectably on price/performance; the other three Cyrix-based entries—the Tandy 3800 HD, the GRiD 1755 486SLC, and the Wyse DecisionMate 486SLC—fell in the mid to low region of the 386SL/25 performance area, with closely clustered prices.

Leading 386-class price/performance entries include the Micro Express NP933—which was the only system to use the AMD386DX/33 chip—and the Compudyne Slimnote 386SL/25-80

Four systems priced under $1,700 provided performance that was low but reasonable enough to be worth a close look: the Primax NightHawk 325SXL ($1,449), Keydata's Keynote 386SX-25 ($1,595), the Compaq Contura 3/20 ($1,608, discounted), and Polywell's Poly NB325T ($1,695). The rest of the 386-based systems were generally clustered in the middle of the group's performance range, within a $1,000 spread between $1,700 and $2,700

THE DATA POINTS

This chart plots each system's selling price (*y*-axis) versus its performance index (*x*-axis). We discounted systems available only through dealers by 15 percent.

The performance index reflects numerous features. DOSmark, Graphics Winmark, and Disk Winmark scores account for 35 percent of the rating, system memory and hard disk size, 16 percent; and the size, weight, and ZDigit Rundown test score (battery life), 11 percent each. The remaining 16 percent is based on display size, I/O ports, PCMCIA slots, internal modem, simultaneous external display capability, super VGA output, extra cursor keys, built-in pointing device, flash BIOS provision, ROM power-conservation features, 16550 UART support, enhanced parallel port, and hot-swap battery change capability. For details, see 22MBANG WK1 in the Software Library of PC MagNet's Editorial Forum.

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The ill-fated "Rhapsody for Subsonic Tubas" was performed only once by Frederick Von Stuckman. The notes were so low, no one could hear them. Requests for encore performances were subsequently low.

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Desktop	CPU	RAM	HD	Floppy	Display	Price
386DX/33	Intel 80386DX-33 MHz	1 standard 32 max	40	1.2 or 1.44	16 bit SVGA card 14" 640x480 VGA Color Monitor	$849 $32/mo*
386DX/33 or 486SX/25	Intel 80386DX-33 MHz or Intel 80486SX-25 MHz, with built-in 8K CPU cache	2 standard 32 max	80	as above	as above	$999 $37/mo*
486SX/25	Intel 80486SX-25 MHz Built-in 8K CPU cache	as above	80	1.2 & 1.44	16 bit SVGA card 14" 1024x768 SVGA Color Monitor	$1,199 $44/mo*
386DX/33 CACHE	Intel 80386DX-33 MHz 64K CPU cache	4 standard 32 max	120	as above	16 bit SVGA card & Hi-Color Support, 14" 1024x768 SVGA .28 Interlaced Color Monitor	$1,399 $52/mo*
486SX/33	Intel 80486SX-33 MHz 8K CPU cache	as above	120	as above	as above	$1,499 $56/mo*
486DX/33 CACHE	Intel 80486DX-33 MHz 128K CPU cache	as above	120	as above	16 bit SVGA card, 1MB Video RAM & Hi-Color Support, 14" 1024x768 SVGA Non-Interlaced Multisync Color Monitor	$1,799 $67/mo*
486DX/50 CACHE	Intel 80486DX-50 MHz 128K CPU cache True 50 MHz CPU	as above	120	as above	as above	$1,999 $74/mo*
486DX2/66 CACHE	Intel 80486DX2-66 MHz 128K CPU cache New Double Clock CPU	8 standard 32 max	200	as above	16 bit SVGA Superfast Windows Accelerator card, 1MB RAM, 14" 1024x768 SVGA Non-Interlaced Multisync Color Monitor	$2,499 $93/mo*

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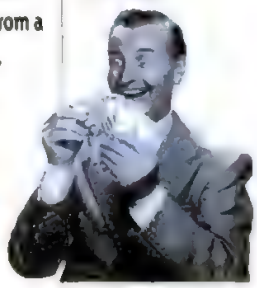

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CIRCLE 132 ON READER SERVICE CARD

The ALR Ranger MC425-120, MC425s-120, M425s-120, M425-120

ing from a 486SX to a 486DX is simple with an optional $699 486DX/25 module: Loosen two screws, remove a panel and the old CPU module, plug in the new one, replace the panel, and tighten the screws.

The plastic Ranger case appears rugged, but when we tested these four systems, one unit's case cover release broke off, and the battery release slide button on another machine came loose. With a battery installed, each of the four Rangers weigh from 7.4 to 7.8 pounds. The 1.2-pound AC adapter increases the total traveling weight to the 8.6- and -9 pound range. An extra battery pack weighs 1.8 pounds. Because of their weights and size (slightly larger than average at 2.3 by 11.8 by 8.5 inches), the ALR Rangers are not designed for casual carrying.

The four 486-based Rangers performed well in terms of the entire roundup. Within their respective processor categories, however, they were average performers. The SX color machine registered a sour note in terms of its Graphics Winmark score.

ALR claims that with power conservation, the nickel cadmium batteries will last 3 to 4 hours for both the color and the monochrome versions. On PC Labs' Battery Rundown test with power conservation disabled, the SX monochrome system lasted the longest (2 hours 32 minutes); next came the DX monochrome unit (2 hours 26 minutes), the DX color model (2 hours 6 minutes), and the SX color system (1 hour 46 minutes).

Power conservation includes a processor sleep mode, an autofast mode, and variable time-out settings to suspend the hard disk, LCD, and processor. The power-management settings are easily accessed and changed through a CMOS setup utility.

The monochrome Rangers use edgelit supertwist Sharp LCD screens measuring 8.5 inches diagonally. You have to fiddle with them a bit to get the brightness and contrast right, and the front viewing angle is limited to about 45 degrees on either side. The Western Digital video controller used in all four Rangers has 256K of video RAM and supports 32 colors or shades of gray at 640-by-480 resolution. The external video port supports up to 800-by-600 with 16 shades or colors, but the Rangers cannot display on both simultaneously.

The 82-key keyboards include 10 half-height function keys, 2 of which serve double-duty as the F11 and F12 keys when used with the Shift key. Of the 8 separate directional keys, the 4 cursor keys are in an inverted-T layout. An Fn

SUITABILITY TO TASK

	POOR	FAIR	GOOD	EXCELLENT
ALR Ranger M425s-120				
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger MC425s-120				
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger M425-120				
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○
ALR Ranger MC425-120				
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

ALR Ranger M425-120

List price (test configuration): $3,390.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: 4MB RAM upgrade, $279; 8MB RAM upgrade, $849; 16MB RAM upgrade, $1,699; external keyboard, $75; docking station, $695; extra battery, $175; adapter for Ethernet LANs, $199; SCSI interface module, $149; 2,400-bps data/9,600-bps send-only fax modem, $195; 9,600-bps fax modem, $345; nylon carrying case, $59.

ALR Ranger M425s-120

List price (test configuration): $2,890.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: M486DX/25 upgrade module, $699. Other options as above.

ALR Ranger MC425-120

List price (test configuration): $4,290.
Tested configuration: 4MB RAM, Toshiba MK212FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, AC power adapter.
Options: As above.

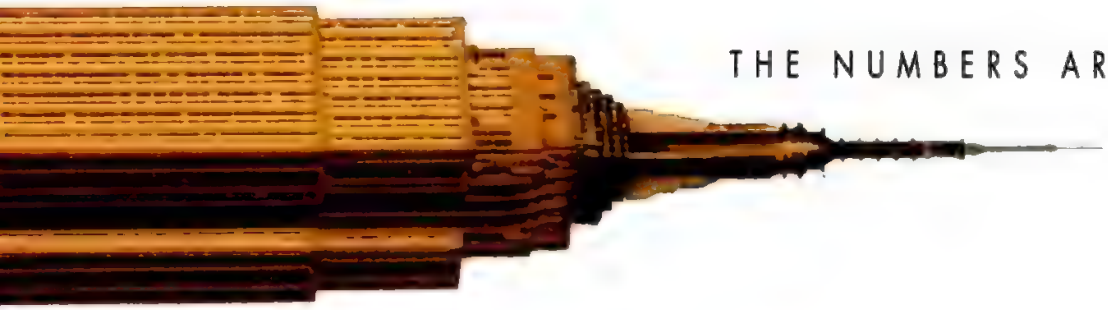
ALR Ranger MC425s-120

List price (test configuration): $3,890.
Tested configuration: 4MB RAM, Toshiba MK2124FC 120MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, adapter for AC power.
Options: M486DX/25 upgrade module, $699. Other options as above.
In short: These machines offer excellent battery life and good performance. The size of the units is larger than average, however.

Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; 800-444-4257, 714-581-6770; fax, 714-581-9240

573 ON READER SERVICE CARD

THE MEETING'S DOWN UNDER.



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CIRCLE 088 ON READER SERVICE CARD

Battery Life vs. Portability

Increasing attention to the traveling executive's wants and needs is evident in this group of 67 portable systems, most of which easily fit into an attache case and weigh just under 8 pounds with AC power adapter included. We subjected each of the systems to PC Magazine Labs' worst-case Battery Rundown test, which measures battery life without any power-conservation features. They also underwent our ZDigit Rundown test, which uses an automated test-bed and specially designed control software to approximate notebook system operation under typical conditions when all power-management features are enabled.

On the Battery Rundown test this group of portables achieved an average operating life of 2 hours 21 minutes, and on the ZDigit test an average of 3 hours 31 minutes—more than an hour of additional life. A few machines—the Toshiba T3300SL, the American Mitac 3027F, the Ergo 486DX/33 NoteBrick II, and the Aspen Aquiline 433—had longer screen and hard disk time-outs, which put them at a marked disadvantage on the ZDigit test. The Zeos Color Notebook could not execute the ZDigit operations because of a power-management BIOS conflict, and the Dell System 320SLi has no ZDigit score because our test does not work with a nonilluminated screen.

Design features such as display type, power management and I/O device control had a direct impact on battery life. Among the seven color systems—the ALR Ranger MC425s-120, the ALR Ranger MC425-120, the Compaq LTE Lite/25c, the Keydata Color Keynote 386SL-25, the Toshiba T4400SXC, the ZDS Z-Note 325SLc Model 120, and the Zeos Color Notebook—three used active-matrix displays, while the ALR, Keydata, and Zeos systems used passive-matrix screens. Yet the expected disparity between active- and passive-screen power consumption was not evident. While the average battery life for the color systems (just under 2 hours) was below the overall average (2 hours 21 minutes), there was no significant difference between the active-matrix and passive-matrix systems. The Toshiba T4400SXC, with an Intel 486SX processor (the only 486 color system) and a 2.3-pound battery (the heaviest of all), was a notable exception. With a Battery Rundown score of 2 hours 31 minutes and a ZDigit score of nearly 4 hours, this system delivered color, processing power, and above-average battery life.

The ALR Ranger M425-120 had the best ZDigit performance (7 hours 41 minutes), but the longest Battery Rundown time was achieved by two of the ZDS Z-Note systems. The Z-Note 320L was tops, at 4 hours 27 minutes (6:03 ZDigit score), and the Z-Note 325L was right behind, at 4 hours 21 minutes (5:36 ZDigit). Both systems use the 3.3-volt Intel 386SL, with a 20-MHz clock rate for the Z-Note 320L and 25 MHz for the Z-Note 325L. Each uses a 1.1-pound nickel hydride battery, which brings the travel weight up to 7.9 pounds. Lighter on the scale (at under 7 pounds) and packing 486 processor punch are two machines from Texas Instruments—the TI TravelMate 4000 WinDX/25 and WinSX/25. These systems had battery lives within 20 minutes of one another (3 hours 28 minutes for the WinDX/25 and 3 hours 46 minutes for the WinSX/25); each uses a 25-MHz 486 chip and the same 1.3-pound nickel cadmium battery.

The Dell System 320SLi was the real featherweight, at just under 5 pounds, with a life of 3 hours 8 minutes from a 0.7-pound battery—the best battery life per pound in the group. In the heavyweight class, the Ergo 486DX-33 NoteBrick II and Aspen Aquiline 433 tipped the scales at 10.2 pounds, with 2.2 pounds in the battery compartment. Breaking the rule of thumb that says "weight generally equals battery life," these systems had rundown times well under 2 hours. Both use 486DX/33 processors, offer large hard disks, and use NTC motherboards with an Award 3.03 BIOS and no ROM power-management features.

Battery Life and Portability

	Processor	ZDigit Rundown time (hours: minutes)	Rank	Battery Rundown time (hours: minutes)	Rank	Battery weight (pounds)	Rank	Battery life per pound (hours: minutes)	Rank	System weight (pounds)	Rank	Travel weight with adapter (pounds)	Rank
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALR Ranger M4[illegible] 120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.8	59	[illegible]	[illegible]	[illegible]	[illegible]	8.8	[illegible]
ALR Ranger [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALR Ranger MC425 120	Intel 486DX/25	04 27	10	02 06	39	1.8	59	[illegible]	[illegible]	7.5	60	9.0	59
ALR Ranger MC425s 120	Intel 486SX/25	03 44	24	01 46	53	1.8	59	[illegible]	[illegible]	7.8	64	9.3	64
Altima 325 80386SL	Intel 386SL/25	03 01	41	02 44	14	1.3	36	02 06	[illegible]	[illegible]	[illegible]	7.6	21
Altima 433 80486DX	Intel 486DX/33	02 47	48	02.12	34	1.3	36	01 41	46	[illegible]	[illegible]	7.7	29
American Mitac 3025F	Intel 386SX/25	03 01	41	02 31	22	1.2	32	02 05	26	[illegible]	[illegible]	8.8	55
American Mitac 3027F	Intel 386SL/25	03 01	41	02 20	31	1.1	24	02 07	27	[illegible]	[illegible]	7.7	29
Amrel MLT486DXU33	Intel 486DX/33	02 47	48	02 08	37	1.3	36	01 38	48	7.3	[illegible]	9.0	59
Aspen Aquiline 433	Intel 486DX/33	02.05	59	01 45	55	2.2	65	00 47	66	8.5	[illegible]	10.2	66
Austin 386SXL-25 Notebook	AMD Am386SXL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	02 36	9	[illegible]	[illegible]	7.9	36
AVI ANB3-386SXL-25	AMD Am386SXL/25	03 02	38	01 58	44	0.8	8	02 27	11	[illegible]	7	[illegible]	[illegible]
BLK 386SL/25NBF	Intel 386SL/25	02 32	55	01 15	67	0.7	1	01 47	40	[illegible]	9	[illegible]	4
Chaplet 386SL/25 Notebook	[illegible]	[illegible]	62	[illegible]	[illegible]	[illegible]	[illegible]	01 58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Compaq Contura 3/20	Intel 386SL/20	[illegible]	7	[illegible]	[illegible]	[illegible]	[illegible]	02 14	[illegible]	[illegible]	13	[illegible]	[illegible]
Compaq Contura 3/25	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	02 02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Compaq LTE Lite/25c	Intel 386SL/25	03.57	20	01 45	55	1.3	36	01 20	61	6.7	44	7.9	36
Compaq LTE Lite/25E	Intel 386SL/25	04 11	15	02 38	18	1.3	36	02 01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CompuAdd Express 425CXL-80	Cyrix CX486SLC/25	02 48	45	02 09	35	0.7	1	03 04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Compudyne Slimnote 386SL/25-80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36	[illegible]	[illegible]	[illegible]	16	7.6	21
Compudyne Slimnote 486SX/25-80	Intel 486SX/25	[illegible]	[illegible]	[illegible]	[illegible]	1.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.6	3
Dell Dimension NL20	Intel 386SL/20	03 30	30	03 12	10	1.4	51	02 17	17	[illegible]	[illegible]	[illegible]	21
Dell System 320SLi	[illegible]	N/A	N/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	4.8	1
Dell System 325N	Intel 386SL/25	05 07	6	03 41	5	1.6	59	02 18	16	[illegible]	[illegible]	[illegible]	[illegible]
Digital DECpc 325p	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16	7.2	13
DTK Grafika 3N	AMD Am386SXL/25	03 29	32	02 03	41	0.9	11	02 16	18	[illegible]	[illegible]	[illegible]	21
Ergo 486DX-33 NoteBrick II	Intel 486DX/33	02 05	59	01 40	58	2.2	65	00 44	67	[illegible]	[illegible]	[illegible]	66
Everex Carrier SL/25	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23	[illegible]	[illegible]
GRiD Convertible	Intel 386SL/25	[illegible]	64	[illegible]	[illegible]	[illegible]	[illegible]	01 02	64	[illegible]	9	[illegible]	[illegible]
GRiD 1660	Intel 386SL/25	04 11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	02 09	21	[illegible]	16	[illegible]	[illegible]
GRiD 1755 486SLC	Cyrix CX486SLC/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29
IBM PS/note N45sl	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	51	[illegible]	[illegible]	[illegible]	[illegible]	8.9	57
Identity 386SXL-25 Notebook Computer	AMD Am386SXL/25	02:34	52	01 45	55	1.0	16	01 45	43	[illegible]	[illegible]	[illegible]	[illegible]
Jetta Jetbook 486DX/33	Intel 486DX/33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9	[illegible]	[illegible]	[illegible]	[illegible]	8.1	[illegible]
Keydata Color KeyNote 386SL-25	Intel 386SL/25	04.39	9	01:58	44	1.0	16	01:58	32	6.7	44	7.6	21
Keynote 386SX-25	AMD Am386SXL/25	03 02	38	01 58	44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.4	51
Keynote 486SLC	Cyrix CX486SLC/25	03 44	24	02 07	38	1.3	36	01:37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leading Edge N3/SL25 Plus	Intel 386SL/25	01 51	62	01 22	65	0.7	1	01 57	36	[illegible]	[illegible]	[illegible]	[illegible]
Librex R386SL	Intel 386SL/25	02 48	45	01 35	59	0.9	11	01 45	43	[illegible]	44	[illegible]	[illegible]
Librex T386SX	Intel 386SX/20	03 30	30	02 23	30	1.0	16	02 23	14	[illegible]	[illegible]	7.6	21
Lightning Thundernote 486DX/33	Intel 486DX/33	02 05	59	01 46	53	1.3	36	01 20	60	[illegible]	[illegible]	[illegible]	42
Matrix 486SX-25Mhz Notebook	Intel 486SX/25	04 12	14	02 01	43	1.2	32	01 40	47	[illegible]	[illegible]	8.0	[illegible]
Micro Express NB486DX	Intel 486DX/33	03 01	41	02 33	20	1.3	36	01 57	35	[illegible]	[illegible]	[illegible]	59
Micro Express NB[illegible]33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	59	[illegible]	[illegible]	[illegible]	[illegible]	8.9	57
Mitsuba Ninja 486SX	Intel 486SX/25	03 44	24	01 47	52	1.1	24	01 37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PC&C Dynova SLic3000	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.0	52	[illegible]	[illegible]
Poly NB325T	Intel 386SXLV/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	54
Poly NBC25	Intel 386SL/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	4	7.0	9
Primax Eagle 425SX	Intel 486SX/25	03.29	32	02 44	14	1.4	51	01 57	35	[illegible]	[illegible]	8.1	[illegible]
Primax NightHawk 325SXL	AMD Am386SXL/25	02.20	57	01 33	61	1.1	24	01 24	57	[illegible]	[illegible]	7.8	33
QSI Klonimus Lite 386SL/25	AMD Am386SXL/25	04 25	11	03 44	4	0.9	11	04 23	[illegible]	[illegible]	[illegible]	9.1	[illegible]
Samsung NoteMaster 386L/25	Intel 386SL/25	N/A	N/A	01 29	62	0.7	1	02 07	22	[illegible]	[illegible]	[illegible]	10
Tandy 3800 HD	Cyrix CX486SLC/20	02:48	45	02 26	27	1.0	16	02 26	12	[illegible]	30	[illegible]	6
TI TravelMate 4000 WinDX/25	Intel 486DX/25	04 25	11	03 28	6	1.3	36	02 40	8	[illegible]	[illegible]	[illegible]	4
TI TravelMate 4000 WinSX/25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6
Toshiba Satellite T1800	Intel 386SX/20	04 13	13	03 18	9	1.6	57	02 03	27	[illegible]	[illegible]	[illegible]	[illegible]
Toshiba T[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Toshiba T4400SXC	Intel 486SX/25	03 58	19	02 31	22	2.3	67	01 05	[illegible]	7.9	65	9.7	65
Twinhead [illegible] 486DX/33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wyse DecisionMate 486SLC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18
ZDS Z-Note 320L	Intel 386SL/20	06 03	3	04 27	1	1.2	32	03 42	4	5.9	16	7.9	36
ZDS Z-Note [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29
ZDS Z-Note [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.9	[illegible]
ZDS Z-Note 325Lc Model 120	Intel 386SL/25	02 33	53	01 51	51	1.2	32	01 32	54	6.6	41	8.0	42
ZDS Z-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Zeos Color Notebook	Intel 386SL/25	N/A	N/A	[illegible]	[illegible]	[illegible]	24	[illegible]	[illegible]	[illegible]	44	7.9	36

Rank: Number 1 represents the top ranking. N/A—Not applicable. This product was not compatible with [illegible]

key used with Shift activates the numeric keypad.

No network or communication features are standard with the Rangers, but the notebooks do have room inside for a fax modem and a SCSI connector card.

ALR's service and support mix includes a one-year parts-and-labor warranty and toll-free technical support on weekdays and Saturdays. There is no money-back guarantee or on-site service, but should you require warranty repairs, ALR pays for shipping both ways. Sold through dealers and VARs, the Rangers are better suited for high-end remote applications that take advantage of the machines' expansion options than for casual users looking for lightweight portable systems.—*Bruce Brown*

Altima Systems Inc.

Altima 325 80386SL

Altima 433 80486DX

Compudyne Products

Compudyne Slimnote 386SL/25-80

Compudyne Slimnote 486SX/25-80

Lightning Computers

Lightning Thundernote 486DX/33

Twinhead Corp.

Twinhead Slimnote 486DX/33

Because the six notebooks covered in this review share a common design and manufacturer, we decided to discuss them in a combination review. Because they have so much in common, the only choice you have to make is which of the four vendors to choose from, which processor type is right for your needs, and how much you are willing to spend for the machine of your choice.

In many cases, the individual vendors provide more than just a label and a box for shipping the machine. They often add modems, docking stations, and most importantly different levels of service and support; such details distinguish these machines from each other.

Differing in small details, these six notebooks are birds of a feather, although the price range from the most expensive to the least expensive is nearly $2,000. Arranged in ascending price, they are the $1,799 Compudyne Slimnote 386SL/25-80 and the $2,199 Compudyne Slimnote 486SX/25-80, the $2,280 Lightning Thundernote 486DX/33, the $2,727 Altima 325 80386SL, the $2,875 Twinhead Slimnote 486DX/33, and the $3,798 Altima 433 80486DX. Price differences are mostly due to the three types of processors that are available—the 386SL/25, 486SX/25, and 486DX/33—and varying hard disks.

Measuring 1.6 by 11 by 8.5 inches, these identical sextuplets each weigh slightly under 6 pounds. With the 1.5-pound AC adapter packed away, the travel weight rises to 7.5 pounds. All six of these machines have clamshell cases that are virtually indistinguishable—with the exception of the Altima 325 and Altima 433, which look and feel as if the company has applied a thin coat of felt to the cases.

Each notebook offers a Twinhead-made motherboard that came with 4MB of RAM and the choice of a 80MB, 120MB, or 130MB hard disk. System memory can be upgraded to 6MB for the 386 machines and 20MB for the 486 portables. All six had an annoyingly small trackball that was uncomfortable to use under the best of circumstances, and too

SUITABILITY TO TASK

Altima 325 80386SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Altima 433 80486DX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	●
Desktop replacement	●	●	●	●

SUITABILITY TO TASK

Compudyne Slimnote 386SL/25-80

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	●
Desktop replacement	●	●	●	●

Compudyne Slimnote 486SX/25-80

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

(l to r) The Altima 433 and 325, the ThunderNote 486DX/33, the Twinhead Slimnote 486DX/33, the Compudyne Slimnote 486SX/25-80 and 386SL/25-80

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The LeaderBooks come standard with 4MB RAM and an 80MB hard drive. And in addition, they combine a full featured 82-key keyboard with a built-in, 2-button Trackball. An easy to read 9-function LCD panel displays the system status including battery life, fax/modem and keyboard. The Dual NiCad battery system even allows you to change batteries while working. With an easy-to-carry third 8 oz battery, you're assured up to5 hours of operation. Also standard are ports for communications, external monitor and numeric keypad.

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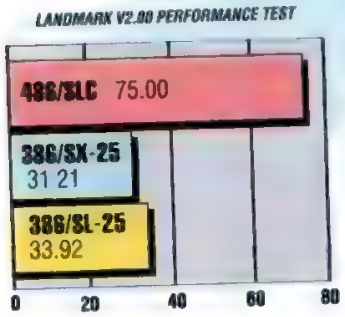

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486/DX2-50 $1995

■ 486DX2-50 processor ■ 64K cache ■ 4MB RAM ■ 105MB drive ■ 1.2MB & 1.44 MB drives ■ 16-bit SVGA with 1MB ■ Color SVGA monitor(1024 x 768, .28) ■ 1 parallel/2 serial ports ■ Upgradable processor ■ 200W power supply ■ 101-key keyboard ■ MS DOS ■ Windows and mouse

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■ 486DX2-66 processor ■ 64K cache ■ 4MB RAM ■ 105MB drive ■ 1.2MB & 1.44 MB drives ■ 16-bit SVGA with 1MB ■ Color SVGA monitor(1024 x 768, .28) ■ 1 parallel/2 serial ports ■ Upgradable processor ■ 200W power supply ■ 101-key keyboard ■ MS DOS ■ Windows and mouse

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▶ BENCHMARK TESTS

What the Numbers Mean: Portables

Test results highlight the importance of the integrated power-management features and cache controller of Intel's 386SL/25 processor. Notebooks with the chip were able to stretch battery life with no compromise on performance.

DOS PROCESSOR AND MEMORY

Eleven different processor levels were represented across the 67 monochrome and color portables tested. CPU processing power ranged from the Librex T386SX (2,157.58 processor operations per second) and the Toshiba Satellite T1800 (2,070.15)—based on the Intel 386SX/20—to a number of 486DX/33 systems led by the Jetta Jetbook 486DX/33 (which scored 8,623.54).

The most popular processor was the Intel 386SL/25, thanks to its integrated power management features and built-in cache controller. Among the 26 systems that used it, the ZDS Z-Note 325L and Z-Note 325Lc Model 120 took top honors, at roughly 3,220 processor operations per second each. In addition, both ZDS systems use a 64K external processor cache and have the fastest memory scores in the group, showing the profound influence memory has on 386-class CPU performance.

Within the AMD Am386SXL/25 category, there was a wide disparity between the fast Austin 386/SXL-25 Notebook (2,810.01 operations per second) and the DTK Grafika 3N (2,376). Neither used an external cache, but the Austin had a noticeably faster memory score due to more efficient DRAM design. All of the Cyrix 486SLC/25–based systems were outperformed by the lone AMD Am-386DX/33–based Micro Express NP933.

DOS VIDEO

While 49 systems used Cirrus Logic video chip sets, the top-performing Toshiba T4400SXC (3,088.87 thousand video operations per second) relied on the Western Digital WD-90C30 chip set with 512K of video RAM. The Toshiba Satellite T1800 and the Compaq units performed exceptionally well and used proprietary video circuitry. The slowest unit was the Cyrix CX486SLC/20–based Tandy 3800 HD, at only 467.3 thousand operations per second.

DOS DISK

Generally, laptop disk performance is slow compared with desktop systems, because of less installed cache. The 486DX33-based Aspen Aquiline 433 delivered 38.08 kilobytes per second using a Seagate 3283A 245MB IDE drive with an average access time of 19 ms and 128K of on-board cache. The Ergo 486DX-33 NoteBrick II used a 16-ms 210MB Maxtor Cheyenne 7213AT drive with 64K cache, delivering a second-place score of 27.18. The AMD Am386SXL/25–based Identity system incorporated a 210MB 19-ms Conner Cougar drive with 256K on-board cache and placed third, with a score of 24.45. At the low end of the disk spectrum was the new Compaq Contura 3/20, a 386SL/20-based unit, scoring only 10.05 using a Compaq/Conner 19-ms 84MB drive with a 32K on-board buffer.

Although higher processor levels are not usually an overwhelming disk performance factor (compared with software and hardware disk caches or mechanically faster drives), they will improve disk scores somewhat. Also, the larger the drive capacity, the less far the heads have to move across the disk surface to perform random read/write operations on the 32MB test file (the largest we used). Reduced head-stroke distance usually means improved performance.

DOSmark

DOSmark scores results depend heavily on disk and CPU speed, and to a lesser extent on memory and video performance. When we developed our Hardware Benchmark Tests, Release 7.0, our application profiles indicated that a large percentage of DOS performance problems are related to slow disk subsystems. Of the top 20 DOS disk performers, 17 were also in the top 20 DOSmark list. The DOSmark champion was the Aspen Aquiline 433, achieving a score of 30.96, thanks to a strong disk subsystem and 486DX/33 processor. Not surprisingly, the new Compaq Contura 3/20, a 386SL/20-based laptop, placed dead last, with a DOSmark score of 9.33, which correlates with its paltry disk score.

CONTINUES

frustrating to attempt under cramped conditions. The 84-key keyboards offered a fairly crisp response, but they often felt cramped and somewhat uncomfortable to use.

While the majority of keys used hard-to-read black-on-gray lettering, the Altima 325 and Altima 433 opted for the more-legible blue-on-white lettering. This small change made a lot of difference, particularly when we used the notebooks in poor lighting. Of the 12 half-height function keys, 2 are embedded, and the cursor keys are in the desirable inverted-T layout.

The bright side was the edgelit 9.5-inch-diagonal Sharp TSTN (triple-supertwist nematic) VGA screens, which are edgelit and consistently offered very readable images from most viewing angles. Driven by a Cirrus Logic video chip set, any of these laptops can simultaneously display to the LCD panel and a Super VGA monitor at 16 colors, which makes any of these notebooks well-suited for those who often do presentations for large groups. All of the units offer parallel, serial, mouse, and keyboard ports, along with an expansion connector for an external 1.2MB floppy disk drive or a docking station.

Despite their common origin, these notebooks exhibited a wide range of per-

GRAPHICS WINMARK

None of the laptops were stellar performers in Winbench 3.1, since none incorporated graphics accelerators or local-bus technology. We tested all systems at 640-by-480 resolution, with 16 colors where applicable. Texas Instruments delivered the best Graphics Winmark score—2.9 megapixels per second—in both the TI TravelMate 4000 WinDX/25 and the WinSX/25, which use the Cirrus CL-GD6420 chip set. The slowest Graphics Winmark score—0.83—came from the 386SL/20-based Dell Dimension NL20, which also uses a Cirrus GD610 chip set.

DISK WINMARK

Since most of the laptops had 4MB of RAM, we set up a 1MB SmartDrive 4.0 cache to represent a typical Windows setup. With SmartDrive loaded, the speed of the CPU and memory subsystems affect overall disk subsystem performance. The Aspen and Ergo units again took top honors in the Disk Winmark category, for the same reasons as in the DOS disk context. 486-based systems generally achieved the best Disk Winmark scores.

HOW WE TESTED

In preparing this issue, we used PC Magazine Labs' new Hardware Benchmark Tests, Release 7.0, to predict PC processor, memory, video subsystem, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests, expressed in terms of throughput or operations per second. These results are summarized in a composite score called the DOSmark.

We also used the new Windows Benchmark Tests (Winbench), Release 3.1, to obtain the Graphics Winmark and Disk Winmark scores, which predict the relative performance levels using popular Windows applications.

The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. It is derived from tests that use small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the presence or absence of a math coprocessor). The score indicates how well a computer's CPU and cache subsystems would execute common DOS and Windows applications.

The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory read and write tests, as well as 8- and 16-bit conventional-memory read and write tests. Taken together, these tests reflect the throughput of a computer's main memory.

The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for a range of file sizes from 256K to 32MB. The tests are performed without software disk caches installed.

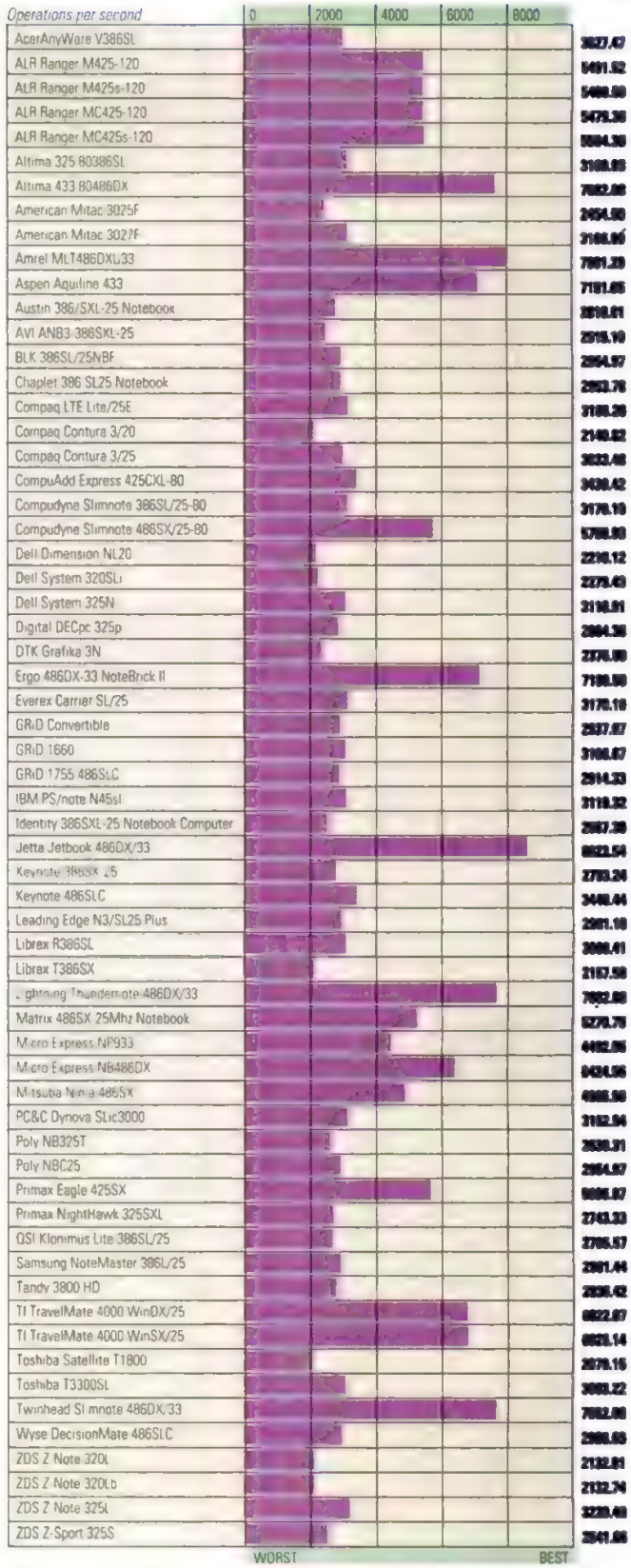
The **video** score is based on direct-to-screen text-write and graphics-write tests. Taken together, these tests reflect the video throughput for a standard EGA/VGA adapter running DOS applications.

The **DOSmark** score is a composite rating derived from the processor, memory, video, and disk test scores. The DOSmark indicates a computer system's ability to run DOS applications.

The **Graphics Winmark** score is based on 12 Windows graphics and text functions derived from extensive profiling of popular Windows applications. It is measured in megapixels per second (a megapixel is 1,048,576 pixels).

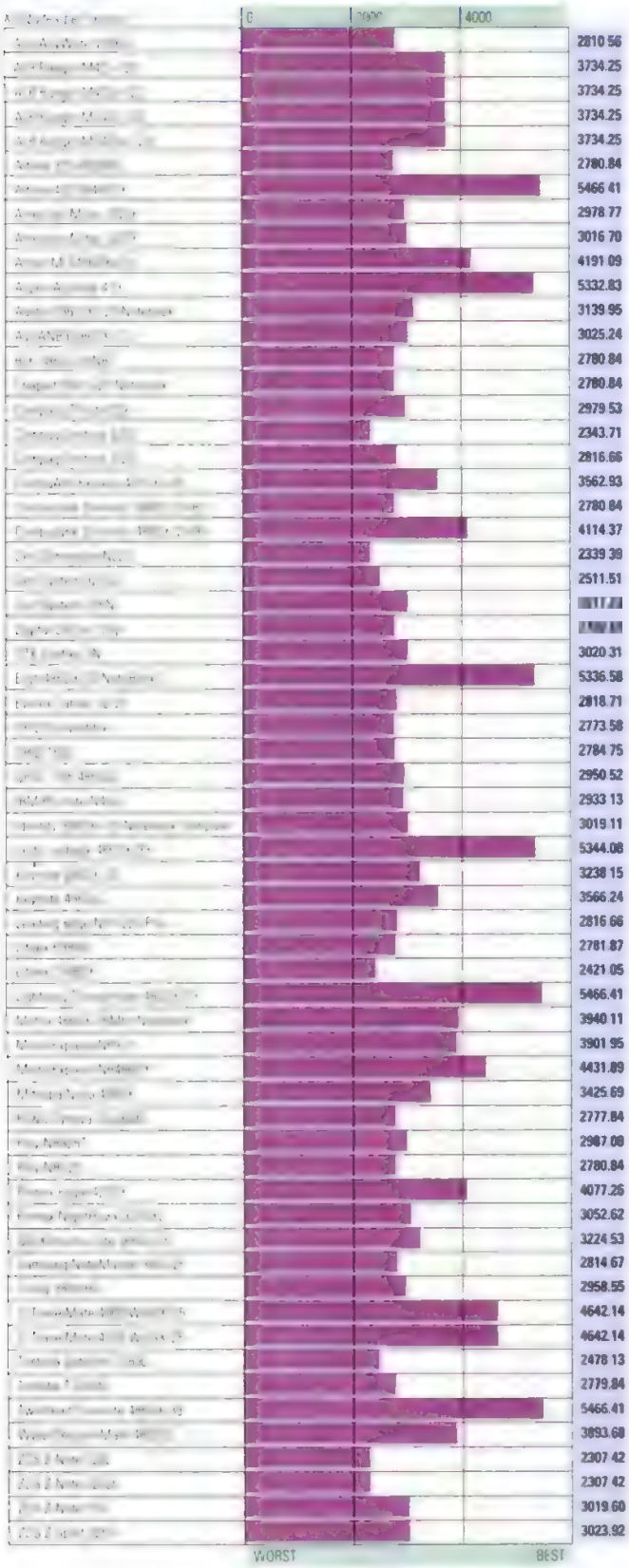
The **Disk Winmark** score is based on testing techniques adapted from the DOS disk tests to reflect operations within the Windows environment. For this portion of the testing, the systems were configured with up to 2MB of SmartDrive cache.

PROCESSOR

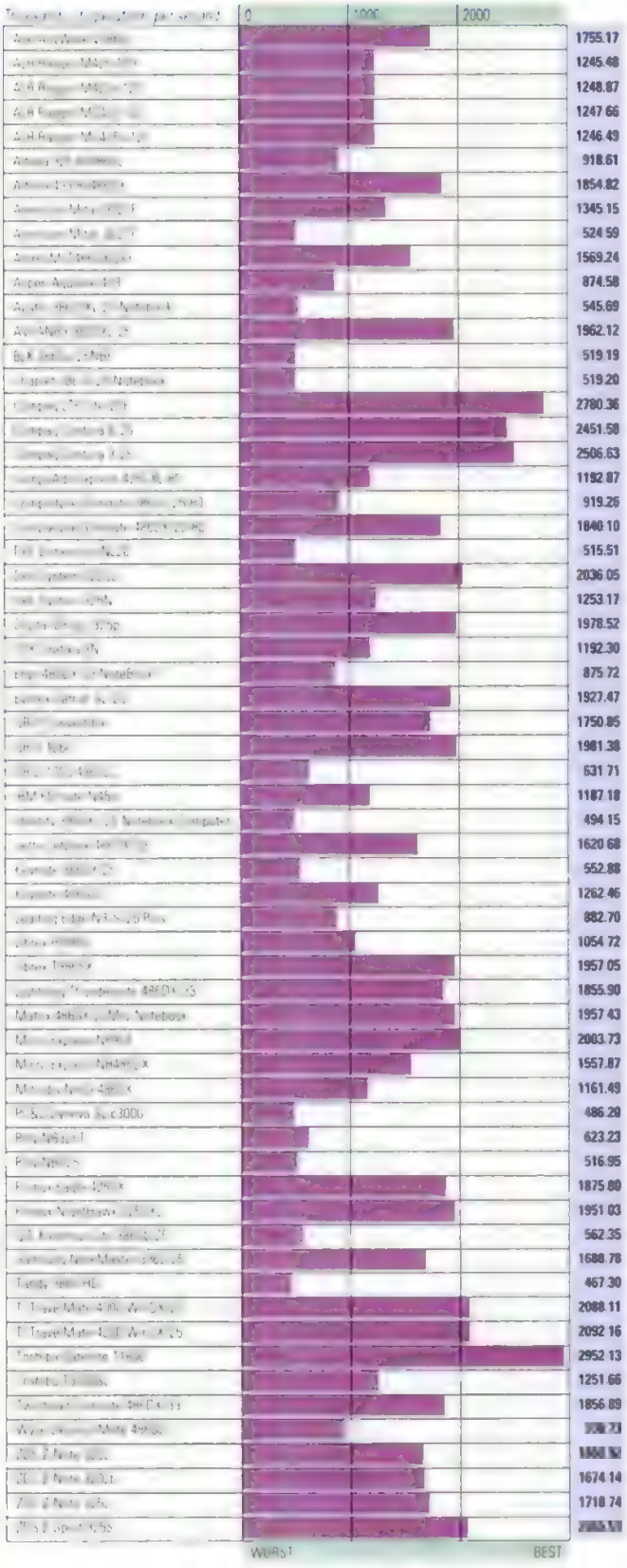


Benchmark Tests: Portables

MEMORY



VIDEO



Benchmark Tests: Portables

DISK

Kilobytes per second	
AcerAnyWare V386SL	17.62
ALR Ranger M425-120	18.62
ALR Ranger M425s-120	20.32
ALR Ranger MC425-120	20.60
ALR Ranger MC425s-120	20.44
Altima 325 80386SL	17.28
Altima 433 80486DX	18.94
American Mitac 3025F	14.21
American Mitac 3027F	14.84
Amrel MLT486DXU33	23.03
Aspen Aquiline 433	30.08
Austin 386/SXL-25 Notebook	15.73
AVI ANB3 386SXL 25	21.57
BLK 386SL/25NBF	15.15
Chaplet 386 SL25 Notebook	16.05
Compaq LTE Lite/25E	15.24
Compaq Contura 3/20	10.05
Compaq Contura 3/25	14.58
CompuAdd Express 425CXL-80	19.64
Compudyne Slimnote 386SL/25-80	13.26
Compudyne Slimnote 486SX/25-80	15.24
Dell Dimension NL20	13.70
Dell System 320SL	13.76
Dell System 325N	15.99
Digital DECpc 325p	15.36
DTK Grafika 3N	15.70
Ergo 486DX-33 NoteBrick II	27.18
Everex Carrier SL/25	15.80
GRiD Convertible	18.38
GRiD 1660	15.40
GRiD 1755 486SLC	13.20
IBM PS/note N45sl	16.01
Identity 386SXL-25 Notebook Computer	24.45
Jetta Jetbook 486DX/33	19.71
Keynote 386SX-25	15.79
Keynote 486SLC	14.90
Leading Edge N3/SL25 Plus	15.51
Librex R386SL	15.06
Librex T386SX	12.06
Lightning Thundernote 486DX/33	18.02
Matrix 486SX 25Mhz Notebook	20.32
Micro Express NP933	18.03
Micro Express NB486DX	20.24
Mitsuba Ninja 486SX	16.50
PC&C Dynova SLic3000	15.75
Poly NB325T	13.67
Poly NBC25	16.17
Primax Eagle 425SX	17.86
Primax NightHawk 325SXL	15.80
QSI Klonimus Lite 386SL/25	15.21
Samsung NoteMaster 386L/25	15.66
Tandy 3800 HD	13.55
TI TravelMate 4000 WinDX/25	22.01
TI TravelMate 4000 WinSX/25	21.43
Toshiba Satellite T1800	13.26
Toshiba T3300SL	15.47
Twinhead Slimnote 486DX/33	19.04
Wyse DecisionMate 486SLC	14.67
ZDS Z-Note 320L	12.77
ZDS Z-Note 320Lb	13.27
ZDS Z-Note 325L	17.95
ZDS Z-Sport 325S	13.08

WORST — BEST

DOSMARK

AcerAnyWare V386SL	14.49
ALR Ranger M425-120	18.38
ALR Ranger M425s-120	19.37
ALR Ranger MC425-120	19.52
ALR Ranger MC425s-120	19.46
Altima 325 80386SL	14.46
Altima 433 80486DX	21.01
American Mitac 3025F	12.13
American Mitac 3027F	13.36
Amrel MLT486DXU33	23.22
Aspen Aquiline 433	30.96
Austin 386/SXL-25 Notebook	13.36
AVI ANB3 386SXL 25	15.04
BLK 386SL/25NBF	13.09
Chaplet 386 SL25 Notebook	13.49
Compaq LTE Lite/25E	13.75
Compaq Contura 3/20	9.33
Compaq Contura 3/25	13.12
CompuAdd Express 425CXL-80	16.49
Compudyne Slimnote 386SL/25-80	12.49
Compudyne Slimnote 486SX/25-80	16.58
Dell Dimension NL20	11.03
Dell System 320SL	11.41
Dell System 325N	13.98
Digital DECpc 325p	13.26
DTK Grafika 3N	12.63
Ergo 486DX-33 NoteBrick II	25.77
Everex Carrier SL/25	13.89
GRiD Convertible	14.62
GRiD 1660	13.59
GRiD 1755 486SLC	12.20
IBM PS/note N45sl	13.95
Identity 386SXL-25 Notebook Computer	15.72
Jetta Jetbook 486DX/33	21.99
Keynote 386SX-25	13.41
Keynote 486SLC	14.15
Leading Edge N3/SL25 Plus	13.41
Librex R386SL	13.65
Librex T386SX	10.66
Lightning Thundernote 486DX/33	20.30
Matrix 486SX-25Mhz Notebook	19.40
Micro Express NP933	17.31
Micro Express NB486DX	20.60
Mitsuba Ninja 486SX	16.41
PC&C Dynova SLic3000	13.62
Poly NB325T	12.08
Poly NBC25	13.55
Primax Eagle 425SX	18.34
Primax NightHawk 325SXL	13.40
QSI Klonimus Lite 386SL/25	13.01
Samsung NoteMaster 386L/25	13.52
Tandy 3800 HD	12.27
TI TravelMate 4000 WinDX/25	22.21
TI TravelMate 4000 WinSX/25	21.84
Toshiba Satellite T1800	10.81
Toshiba T3300SL	13.57
Twinhead Slimnote 486DX/33	21.10
Wyse DecisionMate 486SLC	13.53
ZDS Z-Note 320L	10.80
ZDS Z-Note 320Lb	10.81
ZDS Z-Note 325L	15.08
ZDS Z-Sport 325S	11.78

WORST — BEST

Benchmark Tests: Portables

GRAPHICS WINMARK

Megapixels per second (0 – 1 – 2)	
AcerAnyWare V386SL	1.00
ALR Ranger M425-120	2.27
ALR Ranger M425s-120	2.27
ALR Ranger MC425-120	2.27
ALR Ranger MC425s-120	2.27
Altima 325 80386SL	1.35
Altima 433 80486DX	2.05
American Mitac 3025F	1.41
American Mitac 3027F	0.95
Amrel MLT486DXU33	2.30
Aspen Aquiline 433	2.03
Austin 386/SXL 25 Notebook	0.93
AVI ANB3 386SXL-25	1.30
BLK 386SL/25NBF	0.92
Chaplet 386 SL25 Notebook	0.92
Compaq LTE Lite/25E	1.78
Compaq Contura 3/20	1.34
Compaq Contura 3/25	1.72
CompuAdd Express 425CXL-80	1.78
Compudyne Slimnote 386SL/25-80	1.31
Compudyne Slimnote 486SX/25-80	2.43
Dell Dimension NL20	0.83
Dell System 320SLi	1.40
Dell System 325N	1.50
Digital DECpc 325p	1.64
DTK Grafika 3N	1.30
Ergo 486DX-33 NoteBrick II	2.06
Everex Carrier SL/25	1.63
GRiD Convertible	1.51
GRiD 1660	1.66
GRiD 1755 486SLC	1.15
IBM PS/note N45sl	1.43
Identity 386SXL-25 Notebook Computer	0.87
Jetta Jetbook 486DX/33	2.77
Keynote 386SX-25	0.97
Keynote 486SLC	1.91
Leading Edge N3/SL25 Plus	1.16
Librex R386SL	1.40
Librex T386SX	1.35
Lightning Thundernote 486DX/33	2.73
Matrix 486SX-25Mhz Notebook	2.40
Micro Express NP933	2.05
Micro Express NB486DX	2.34
Mitsuba Ninja 486SX	2.00
PC&C Dynova Slic3000	0.90
Poly NB325T	1.02
Poly NBC25	0.93
Primax Eagle 425SX	2.46
Primax NightHawk 325SXL	1.61
QSI Klonimus Lite 386SL/25	0.98
Samsung NoteMaster 386L/25	1.34
Tandy 3800 HD	0.83
TI TravelMate 4000 WinDX/25	2.90
TI TravelMate 4000 WinSX/25	2.90
Toshiba Satellite T1800	1.35
Toshiba T3300SL	1.44
Twinhead Slimnote 486DX/33	2.73
Wyse DecisionMate 486SLC	1.27
ZDS Z Note 320L	1.20
ZDS Z Note 320Lb	1.23
ZDS Z Note 325L	1.50
ZDS Z-Sport 325S	1.53

WORST — BEST

DISK WINMARK

Kilobytes per second (0 – 10 – 20 – 30)	
AcerAnyWare V386SL	15.80
ALR Ranger M425-120	19.78
ALR Ranger M425s-120	18.49
ALR Ranger MC425-120	19.67
ALR Ranger MC425s-120	21.29
Altima 325 80386SL	14.48
Altima 433 80486DX	21.30
American Mitac 3025F	12.21
American Mitac 3027F	12.57
Amrel MLT486DXU33	24.00
Aspen Aquiline 433	37.58
Austin 386/SXL 25 Notebook	13.63
AVI ANB3-386SXL-25	18.36
BLK 386SL/25NBF	12.58
Chaplet 386 SL25 Notebook	12.95
Compaq LTE Lite/25E	12.68
Compaq Contura 3/20	9.05
Compaq Contura 3/25	12.99
CompuAdd Express 425CXL-80	17.74
Compudyne Slimnote 386SL/25-80	13.39
Compudyne Slimnote 486SX/25-80	19.89
Dell Dimension NL20	16.05
Dell System 320SLi	11.80
Dell System 325N	13.51
Digital DECpc 325p	13.38
DTK Grafika 3N	13.17
Ergo 486DX-33 NoteBrick II	29.74
Everex Carrier SL/25	14.45
GRiD Convertible	14.32
GRiD 1660	13.56
GRiD 1755 486SLC	18.17
IBM PS/note N45sl	13.82
Identity 386SXL-25 Notebook Computer	21.93
Jetta Jetbook 486DX/33	25.15
Keynote 386SX-25	12.35
Keynote 486SLC	18.23
Leading Edge N3/SL25 Plus	13.51
Librex R386SL	13.63
Librex T386SX	10.47
Lightning Thundernote 486DX/33	22.43
Matrix 486SX-25Mhz Notebook	20.74
Micro Express NP933	17.46
Micro Express NB486DX	14.08
Mitsuba Ninja 486SX	18.93
PC&C Dynova Slic3000	13.71
Poly NB325T	12.06
Poly NBC25	13.23
Primax Eagle 425SX	18.12
Primax NightHawk 325SXL	13.68
QSI Klonimus Lite 386SL/25	12.44
Samsung NoteMaster 386L/25	13.58
Tandy 3800 HD	10.01
TI TravelMate 4000 WinDX/25	24.08
TI TravelMate 4000 WinSX/25	23.54
Toshiba Satellite T1800	10.40
Toshiba T3300SL	13.67
Twinhead Slimnote 486DX/33	22.24
Wyse DecisionMate 486SLC	12.11
ZDS Z Note 320L	10.55
ZDS Z-Note 320Lb	9.99
ZDS Z-Note 325L	14.49
ZDS Z-Sport 325S	11.41

WORST — BEST

SUITABILITY TO TASK

Lightning ThunderNote 486DX/33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

SUITABILITY TO TASK

Twinhead Slimnote 486DX/33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	●
Desktop replacement	●	●	●	●

FACT FILE

Altima 325 80386SL

Altima 433 80486DX

Altima Systems Inc., 1390 Willow Pass Rd., # 1050, Concord, CA 94520; 800-356-9990; 510-356-5600; fax, 510-356-2408

List price (tested configuration): $2,727 (325 80386SL); $3,798 (433 80486DX).
Tested configuration: 64K cache; Western Digital WDAH280 80MB hard disk (325 80386SL); Toshiba MK2124FC 120MB hard disk (433 80486DX). 4MB RAM, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive, 256K 70-ns video DRAM, edge-lit Sharp LM64D723 TSTN display.
Options: 4MB RAM upgrade, $449;1.2MB external floppy drive, $299; docking station, $599; trackball, $129; 2,400/9,600-bps MNP5 fax modem, $299.
In short: The Altimas are solid performers, but they fall a bit short of the competition on price.
574 ON READER SERVICE CARD

formance results, an indication that quality control may have been lacking during their manufacture. The low points of our benchmark testing were the low DOS disk scores shown by the Altima 325 and the 386SL/25 Compudyne. Also, the Lightning came in last among portables based on the 486DX/33 processor in terms of its disk result. All were near the mean or below when it came to their DOSmark scores, which indicate each PC's ability to run DOS applications.

FACT FILE

Compudyne Slimnote 386SL/25-80

Compudyne Slimnote 486SX/25-80

Compudyne Products, 15151 Surveyor, Addison, TX 75244; 800-932-2667

List price (tested configuration): $1,799 (386SL/25); $2,199 (486SX/25).
Tested configuration: 4MB DRAM, Toshiba, Conner 80MB hard disks, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive.
Options: 486SX—4MB RAM upgrade, $229; 16MB, $1,799; 9,600/2,400 send/receive MNP5 fax modem, $199.
In short: Full-featured and competitively priced, the Compudyne Slimnote portable line has some shortcomings, but the machines are full-featured and come at ultracompetitive prices.
576 ON READER SERVICE CARD

The most impressive performers were the Altima 433 and the Lightning, whose memory and video scores were at the top of the 486DX/33 class. The Altimas seesawed in terms of their processor and disk scores, with the 386SX model above the average and the 486DX way below the mean. The latter, however, had the fastest memory score of all 62 portables in this section.

Based on the same 62 notebooks, the battery lives for these six ranged from average to dismal. On our Battery Rundown test without power conservation, scores spanned from 2 hours 27 minutes for the 486SX/25 Slimnote to 1 hour 46 minutes for the Lightning. Falling in between were the Twinhead at 2 hours and 4 minutes, the Altima 433 at 2 hours and 12 minutes, the 386SL/25 Slimnote at 2 hours 20 minutes, and the Altima 325 at 2 hours and 44 minutes.

Power conservation on all includes a suspend mode, a nearly identical cover-closed mode, and LCD and hard disk timeouts. The battery supports both quick charge and trickle charge. A major problem we encountered was that after about an hour of operation, these notebooks tended to heat up, which means that they can become quite uncomfortable to rest on your lap for an extended period of time.

With all power-conservation features enabled, they made a stronger showing on our ZDigit Rundown test. Not surprisingly, the Slimnotes led the pack: the 386SL stayed on the longest at 3 hours 44 minutes, and its 486SX/25 cousin lasted 3 hours 30 minutes. Next came the Altimas, with the Altima 325 managing a score of just over 3 hours, and the Altima 433 lasting 2 hours 47 minutes.

Warranties and service separates these notebooks from the others in this story. All four vendors back their products with the expected one-year parts-and-labor warranty. Altima adds lifetime toll-free technical support for the original owner, a 24-hour turnaround on repairs (the customer pays for shipping to Altima), and overnight replacement within the first 30 days. Twinhead Corp.

FACT FILE

Lightning Thundernote 486DX/33

Lightning Computers, 340 Brannan St., San Francisco, CA 94107; 800-347-4486

List price (tested configuration): $2,280.
Tested configuration: 4MB RAM, Toshiba MK2124 130 hard disk, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive, backlit Sharp CCFT display, 2,400/9,600-bps fax modem.
Options: 4MB upgrade, $300; external 1.2MB floppy disk drive, $95; Ethernet network adapter, $199; Token-Ring adapter, $279.
In short: A decent performer for the price, the Thundernote loses points for its short-lived battery.
ON READER SERVICE CARD

FACT FILE

Twinhead Slimnote 486DX/33

Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; 800-995-8946; 408-945-0808; fax, 408-945-1080

List Price (tested configuration): $2,875.
Tested configuration: 4MB RAM, Toshiba MK2124FC 130MB hard drive, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive, edge-lit Sharp CCFT display.
Options: 4MB RAM upgrade, $270; 16MB, $1,750; 9,600/2,400-bps send/receive fax modem, $190.
In short: Good performance is balanced by a high price compared to similar units.
ON READER SERVICE CARD

SOME PEOPLE THINK BUYING A PC IS A HIGH-STAKES GAMBLE

WANNA BET?

CUT THE RISK WITH COMPUADD'S NEW MC SERIES FOR "MISSION CRITICAL" APPLICATIONS.

THE "MISSION-CRITICAL" SERIES. Now CompuAdd gives you guaranteed security in your computer system, whether it's for a small-business application or a networked multi-node environment. The MC Series assures you of only the highest-quality PC components and provides the wide range of operating system coverage required by 32-bit operating systems.

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NETWORK CERTIFIED. Each server in the MC Series is Novell and LAN Man network certified. Novell Netware can even be preloaded—you'll only need a network card to get the system network ready. And, in partnership with Memorex-Telex, CompuAdd will now offer even more comprehensive PC and multivendor network assistance, such as global service, complete installation and configuration, a FastStart support program, and more!

4-HOUR RESPONSE TIME. Because some things are inevitable, on the MC Series CompuAdd offers the peace-of-mind of a four-hour on-site response time on service calls in 50 major U.S. metropolitan areas. And in most other market areas, next-day service is standard.

BEST SUPPORT IN THE BUSINESS. CompuAdd has the winning hand when it comes to other services also. 24-hour toll-free tech support comes free with all CompuAdd systems. We offer flexible limited warranties. Our toll-free, unlimited HelpLine is geared specifically to the concerns of first-time PC buyers. And our Direct Effect line lets you call toll-free 24 hours a day to have technical specifications on our systems faxed to you.

A 10-YEAR WINNING STREAK. While other computer sellers come and go, CompuAdd has been providing the best systems for the best prices for ten years now. So you not only get stability in your PC, you get stability in your PC provider.

CALL NOW. And your winnings are guaranteed!

intel inside

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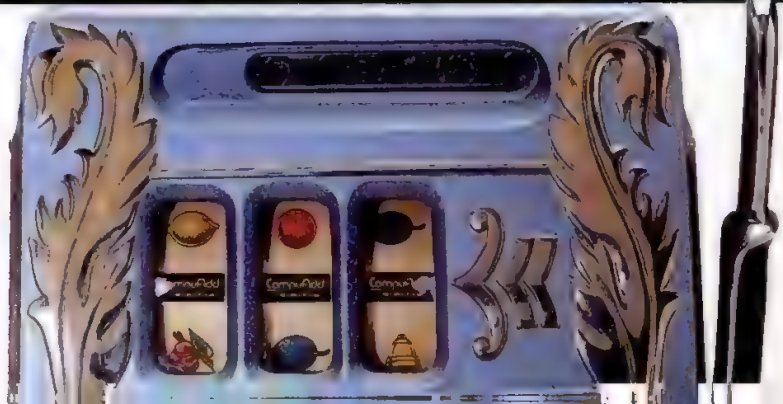

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THE MC SERIES: COMPU

COMPUADD MC425S LO-PRO

A low-profile chassis

*Features an Intel486SX microprocessor running at 25MHz

120MB hard drive
Optional hard drives: 240MB or 540MB

4MB RAM upgradeable to 32MB

Dual floppy drives (3.5" and 5.25")

IDE on-board adapter

Hi Resolution local-bus video adapter

14" VGA color monitor, non-interlaced (15", 17" available)

MS-DOS and Windows 3.1 preloaded
Novell, and UNIX certified

Network board options include NDC Token Ring or Ethernet, SMC8013 Ethernet

One-year free onsite service

$2,115

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COMPUADD MC450DX LO-PRO

A low-profile chassis

*Features an Intel486DX2 microprocessor bringing you 50MHz performance using Intel's speed-doubling technology

240MB hard drive
Optional hard drives: 120MB or 540MB

16MB RAM upgradeable to 32MB

Dual floppy drives (3.5" and 5.25")

IDE on-board adapter

Hi Resolution local-bus video adapter

14" VGA color monitor, non-interlaced (15", 17" available)

MS-DOS and Windows 3.1 preloaded
Novell, and UNIX certified

Network board options include NDC Token Ring or Ethernet, SMC 8013 Ethernet

One-year free onsite service

$2,795

COMPUADD MC433E DESKTOP

A desktop power chassis

*Features an Intel486DX microprocessor running at 33MHz

240MB hard drive
Optional hard drive: 540MB

4MB RAM upgradeable to 64MB

EISA-based motherboard

Dual floppy drives (3.5" and 5.25")

IDE on-board adapter

Accelerated ISA-bus video adapter (supports up to 1024x768, 256 colors, @72Hz)

ATI Ultra-Pro local-bus video accelerator card upgrade (20 million+ WINmark performance)

14" VGA color monitor, non-interlaced (15", 17" available)

MS-DOS and Windows 3.1 preloaded
Novell, LAN Man, and UNIX certified

Network board options include Proteon EISA or NDC Token Ring, or Intel EISA Ethernet or SMC 8013 Ethernet

One-year free onsite service

$3,195

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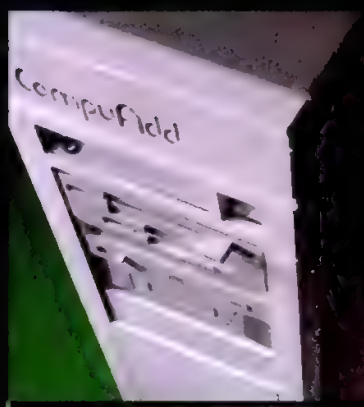
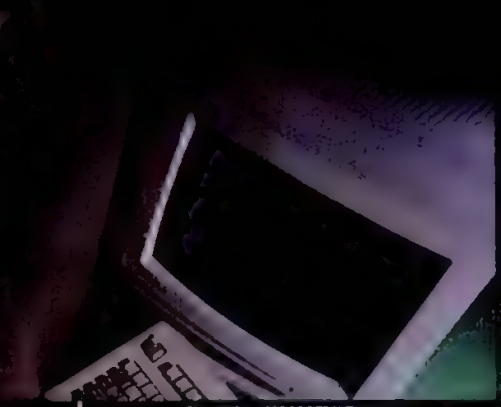
- REMOTE NOVELL SUPPORT
- NOVELL TRAINING AT NOVELL-AUTHORIZED REGIONAL TRAINING CENTERS, OR ON SITE
- FASTSTART SUPPORT PROGRAM — 30-DAYS OF SUPPORT FOR ON-SITE ADMINISTRATION AND TRAINING, INCLUDING FINAL CERTIFICATION OF THE NETWORK

ADD'S "SURE THING"





CompuAdd MC466EDX Desktop

A desktop power chassis

*Features an Intel486DX2 microprocessor bringing you 66MHz performance using Intel's speed-doubling technology

240MB hard drive
Optional hard drive: 540MB

16MB RAM upgradeable to 64MB

EISA-based motherboard

Dual floppy drives (3.5" and 5.25")

IDE on-board adapter

Accelerated ISA-bus video adapter (supports up to 1024x768, 256 colors, @72Hz)

ATI Ultra-Pro local-bus video accelerator card upgrade (20 million+ WINmark performance)

14" VGA color monitor, non-interlaced (15", 17" available)

MS-DOS and Windows 3.1 preloaded
Novell, LAN Man and UNIX certified

Network board options include NDC Token Ring or Ethernet, SMC 8013 Ethernet, Intel EISA, Proteon EISA

One-year free onsite service

$4,195

CompuAdd MC433E Tower

A floor-standing network server chassis

*Features an Intel486DX microprocessor running at 33MHz

500MB SCSI-2 hard drive
10MB/sec SCSI transfer rate
Optional hard drive: 1.2GB

16MB RAM upgradeable to 64MB

EISA-based motherboard

Dual floppy drives (3.5" and 5.25")

Bus master EISA SCSI controller

Accelerated ISA-bus video adapter (supports up to 1024x768, 256 colors, @72Hz)

ATI Ultra-Pro local-bus video accelerator card upgrade (20 million+ WINmark performance)

14" VGA color monitor, non-interlaced (15", 17" available)

Optional Wangtech 51000ES 1GB tape drive

MS-DOS and Windows 3.1 preloaded
Novell, LAN Man and UNIX certified

Network board options include Proteon EISA Token Ring, or Intel EISA Ethernet or SMC 8013 Ethernet

One-year free onsite service

$4,995

CompuAdd MC466EDX Tower

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—*Robert Anthony and Oliver Rist*

American Mitac Corp.

American Mitac 3025F
American Mitac 3027F

Besides attractive pricing, the American Mitac 3025F and American Mitac 3027F each have low weight, a usable though nonstandard keyboard, and solid construction. Although a no-frills approach might characterize American Mitac Corp.'s entries, these portables have many desirable features. Unfortunately, we had to requisition three 3025F units before getting one that worked properly.

The $2,019 3027F is the company's attempt at a high-performance, small, and relatively light portable (6.3 pounds with a battery) that contains some high-tech features. An optional 9,600-bps fax modem is $154.

The $1,899 3025F weighs 6.9 pounds and measures 2.5- by 11.5- by 8.5 inches. Ports are rear-mounted and include all the expected essentials except a PS/2-style mouse port. At just over 1 pound, each unit's AC power adapter isn't overly heavy. The 82-key keyboard has generously spaced keys. However, with a nonstandard layout that leaves no room for separate Home, End, PgUp, and PgDn keys and drops the cursor keys into a reclined-L layout. The Mitacs failed miserably in one respect: Their keyboards offered no resistance.

Each of the two Mitacs use a Mitac system board with a flash upgradable Phoenix BIOS, a Conner 80MB hard disk with an internal 32K buffer, and a Cirrus video chip set that allows the portables to support an external VGA monitor, but not simultaneously. Both use Sharp TSTN (triple-supertwist nematic) LCD panels. While the 3027F uses the 386SL/25 processor and has a 16K external RAM cache and between 2MB and 10MB of RAM, the 3025F relies on the 386SX/25 processor, lacks an external cache, and is constrained by a maximum of 6MB of RAM.

SUITABILITY TO TASK

American Mitac 3025F

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

American Mitac 3027F

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The 3025F registered itself as an average performer in all categories. Its nickel cadmium battery lasted 2 hours 31 minutes on our Battery Rundown time without power conservation and an additional half-hour with power conservation on our ZDigit Rundown test.

The 3027F's results weren't as mainstream: No serious flaws, but its video scores were low under DOS and Windows. With its more advanced power-saving features, (including a switch-activated stand-by mode), the 3027F model managed a ZDigit Rundown score of 3 hours and 1 minute. Its Battery Rundown time without power conservation was average, at 2 hours 20 minutes.

The American Mitac 3025F and American Mitac 3027F

American Mitac issues the same one-year parts-and-labor warranty to all its portables, with on-site service available for an extra charge.—*OR*

FACT FILE

American Mitac 3025F

American Mitac 3027F

American Mitac Corp., 48571 Milmont Dr., Fremont, CA 94538; 800-777-1688

List price (tested configuration): $1,899 (3025F); $2,019 (3027F)

Tested configuration: 5MB DRAM (3025F); 4MB DRAM (3027F) Conner CP-2088 80MB IDE hard disk, Sharp edge-lit LCD screen; 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: Math coprocessor, $177; internal fax modem, $154 (3025F); internal fax modem, $149 (3027F) 1MB RAM upgrade, $54

In short: American Mitac's low-cost 3025F suffered three failures during our testing The company's 3027F model is impaired by a nonstandard keyboard. Check out some of the other products reviewed here

590 ON READER SERVICE CARD

Amrel Technology Inc.

Amrel MLT486DXU33

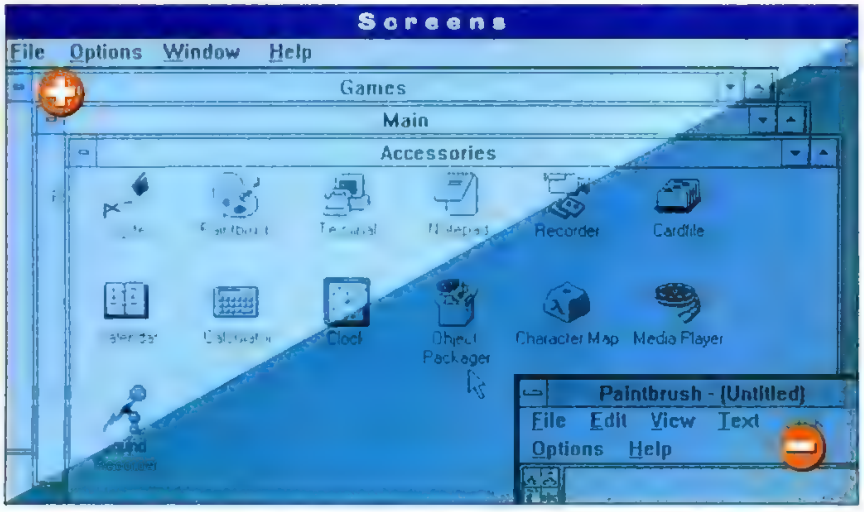
Top performance scores make the Amrel MLT486DXU33 stand out from the 62 portables in this section: It placed in the top 5 on four tests and in the top 15 on two others. This $2,799 486DX/33 also has a respectably long battery life.

The Amrel MLT486DXU33

The Amrel measures 2.5 by 11.5 by 8.5 inches and weighs 9 pounds with a battery, an AC adapter, and a power cord. It comes with one parallel, serial, VGA, and external keyboard port, along with a modem jack. The daughterboard is upgradable, but Amrel Technology recommends that only authorized dealers or

Beyond Performance: *A Gallery of Good and Not-So-Good Features*

A notebook is a notebook is a notebook? Hardly. Besides performance, there are many features that differentiate these portable systems from one another.



The superiority of active-matrix color over passive-matrix color is obvious, but a similar ranking exists between monochrome screens, too. The superb active-matrix monochrome LCD panel on the new Compaq LTV Elite/25E (left) has better contrast and produces sharper images than the low-cost Compaq Contura 3/20 (right).

Many laptops use ribbon-pull batteries; should the plastic door break, the battery can easily fall out. The Librex T3865X has one of the easiest to use yet reliable battery ports we encountered.

Nobody has invented a perfect track ball, but the Librex R3865L has come very close. Not only can it plug into either side of the case side to accommodate both right- and left-handed users, it can also be stowed when not in use.

Portable computing is all about stuffing as much power as possible into your briefcase. The thicker your notebook, the more difficult a time you'll have packing it and the reasoning goes the less likely you'll be to take it on the road. The ALR Ranger MC425s-120 (right) is about 2.3 inches thick, while the Dell System 320SLi (left) is only 1.3 inches thick—the thinnest in our test. A suitable mix balances performance and portability.

Photography by Thom O'Connor

Monitor Support

If you're interested in connecting to an external monitor you've probably found at one time or another that external VGA is inadequate. The two TI TravelMate portables can support an external resolution of 1,024-by-768.

Screen Position

The ability to fold your laptop underneath the monitor is a desirable one. The Chaplet 386 SL25 Notebook, for example, can fold its display flat, tucking under an external monitor.

Docking Stations

Compaq's bulky $799 docking station (left) offers two internal expansion slots, two drive bays, and its own power supply, but it raises the laptop about 3 inches from the desk. Minimalist alternatives include the Ergo offering's $295 station (center), which plugs into the notebook's back and ZDS's $108 port replicator (right).

AC Adapter

Sure, your laptop is small, but if your AC adapter is klunky, you're right back to square one. The new Toshiba Satellite T1800 offers not only a small AC brick but also two-prong power plug, which means you don't need to use a three-prong outlet or pack a three- to two-prong adapter in your already crowded briefcase.

Screen Width

Although active-matrix color offers the best clarity, this type of screen is usually disappointingly small (the Toshiba T4400SXC's 8.5-inch-diagonal display is an example). If color or monochrome active-matrix technology is not important to you, look for a nice, wide display like the one that comes with the GRiD 1660.

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The MicroWarehouse 386/SX33

The 386/SX features a speedy 33 MHz microprocessor equipped with 2 MB of RAM (upgradable to 16 MB). The built in IDE hard disk drive holds a whopping 80 MB of applications and data. It includes both 1.44 MB 3.5" and 1.2 MB 5.25" floppy drives, 2 serial ports and 1 parallel port, and five 16-bit expansion slots available. Plus all the extras you'll need, including a 101-key enhanced keyboard with 12 function keys, a Goldstar 14" VGA Color Monitor (.51 mm dpi) with pre-installed card, and DR DOS 6.0 fully loaded and ready to run. You won't find a better value anywhere, and the 386/SX 33 is fully backed by a one year warranty, and the MicroWarehouse 120 day guarantee

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$999

Kurta XLP - 12" x 12"

The easy-to-use, versatile XLP features Summagraphics M1201 format compatibility and runs on virtually all software. The highly accurate 12" x 12" active area gives you up to 1016 PPI in tablet mode (200 PPI in mouse mode). It includes a two-switch pen and programmable four-button cursor, an integrated mouse/ADI driver with autotoggle between mouse and ADI modes (and a Windows driver in absolute mode), a manufacturer's lifetime warranty and unlimited technical support. Installation and configuration are easy and no power supply is needed

Manufacturer: Kurta Corp.
IN2710

$279

CorelDRAW! 3.0

A new Era in PC Graphics! CorelDRAW, winner of over 50 international awards, is the PC graphics software for everyone! CorelDRAW 3.0's enhanced features include graphic design layers, editable preview, improved 3D effects; and powerful data-driven charting, paint and photo editing, and presentation packages: CorelCHART, Corel PHOTO-PAINT, and CorelSHOW. It comes with 153 TrueType fonts, and over 4600 symbols and clip art images. And as an unprecedented bonus, Corel has included a CD-ROM with over 12,000 clip art images and over 250 fonts! Also included: dozens of fill patterns, dotted and dashed line styles, and arrowheads, 31 import/export filters, free Pantone and TRUMATCH licenses, and free utility programs - CorelTRACE, and Mosaic. **Also Available on CD ROM. CD0580 $369.95. Publisher: Corel Systems**
GR5443/5

$389.95

DesktopTV

DesktopTV enables you to display full color and full motion pictures from any standard video source (broadcast, cable, VCRs, videodisc players, and camcorders) and includes a 119 channel tuner. The software runs under windows 3.0 or under DOS as an application or as a TSR. The on-screen control panel provides access to any video source, channel selection, volume control, mute, favorite channel selection, and control over brightness, color, contrast and tint. Requires a 286- or 386 based PC with an ISA Bus and a VGA card, and a VGA monitor that supports 31.5 kHz.

Manufacturer: Visionx
EX1940

$249

★Outside In for Windows

Outside In is the easiest way to view files and combine data from spreadsheet, database, word processing, compressed and graphic files. Automatically view more than 120 DOS, Windows and Mac formats. Paste all or part of the file anywhere in Windows. Integrates into Windows E-mail programs to view mail attachments. Use it stand-alone or run it inside Word, WordPerfect, Ami Pro, Norton Desktop and other programs. Now includes file management.

Publisher: Systems Compatibility Corporation
UT3144

$65

WordPerfect 5.1

WordPerfect 5.1 is easy to learn, and comes packed with features, including pull-down menus and mouse support, an equation editor, and a new tables feature. Among its high points are automatic formatting and pagination, vertical text centering, red lining, outlining, an enriched mail merge function, a macro library, a spelling checker, and a thesaurus. WordPerfect also prints multiple columns and imports graphics. It manages long documents, and can generate a table of contents, plus indexes, footnotes and endnotes. **Also available: *New Version WordPerfect 5.2 for Windows* WP1973/5 $289.**
Publisher: WordPerfect Corporation

***WordPerfect 5.1* WP0363/5**

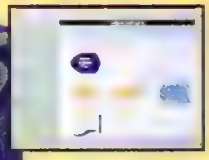
$269.95

★Aldus® Gallery Effects™

Aldus Gallery Effects is a library of artistic effects that automatically transforms grayscale or color scanned photographs and other bitmap images into stunning, sophisticated works of art. Use Gallery Effects' plug-in filters directly in programs like Aldus PhotoStyler, or use the separate application. Sixteen master effects, including Graphics Pen, Watercolor, Emboss, and Charcoal. Thousands of variations from each effect. A "must have" for any scanner user.

Publisher: Aldus
GR5294

$139



★Visio

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$199

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— PC Computing 12/91

Norton Desktop 2.0 for Windows
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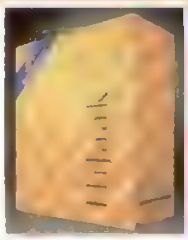
★HiJaak for Windows



HiJaak for Windows is the graphics tool that lets you convert, view, enhance, and print graphics images. HiJaak supports formats for hundreds of applications, converting 23 raster formats (plus - hundreds of "flavors" of TIFF), 15 vector formats, and 24 popular fax card formats. Capture graphics screens from Windows applications, and send them to the clipboard, a printer, a preview window, or a graphics file. HiJaak seamlessly integrates into your Windows applications as an OLE server. HiJaak for Windows also captures graphics and text screens from DOS applications.

Publisher: Inset Systems UT2414

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4 1/2 Mice/MacUser - 4 Stars/Publish
Publisher: Postcraft International GR5165

$75

★Aldus PageMaker 4.0

PageMaker 4.0's Story Editor lets you edit, import, or create stories and check spelling by opening an editing window. Close the window, and PageMaker reflows the text automatically. The new book feature allows you to combine multiple files for chain printing, and generate indexes and tables of contents across multiple documents. The Links Manager keeps track of the status of all placed text, spreadsheet, database, and graphics files. *For a limited time Adobe Type Manager is included free.* Requires Windows 3.0 or later, a hard disk drive, 2MB RAM, mouse, and a 286-based PC or higher.

Publisher: Aldus GR2054/5

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BS0773/5	◆dBASE IV 1 5	558
BS7183/5	◆Paradox 4 0	578
BS3044	◆Quattro Pro 4 0	319
Calera		
UT2304	★FAXGrabber	105
Central Point Software		
UT2874	Central Point Anti-Virus 1.3	95
UT3033/5	★PC Tools 8.0	129
Chronologic Corp.		
UT0584	Instant Recall 2.0	89
Computer Associates		
BS5543	★dBFast	349
FN0523	★ACCPAC Simply Accounting for Win	119
GR1823	CA Cricket Graph 1.3	85
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BS6954	★ACT! for Windows	249
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UT2844	★WinSleuth Gold 3 0	105
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CM0634	PROCOMM PLUS for Windows	95 95
DCA, Inc.		
CM0664	★Crosstalk for Windows 2.0	119
CM0034	Crosstalk Mk4 2 1	165
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BS2604	★PerFORM PRO 3 0	185
FX0154	★WinFax Pro 2 0	75
BS0853/5	PerFORM Pro Designer & Filler 2.1	90.
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UP0233/5	◆OS/2 2 0 Upgrade DOS	95
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FN0164	Quicken 6 0	43
FN0564	★Quicken for Windows	49
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BS7014	★◆Ami Pro 3.0	249
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BS5713/5	★Lotus Freelance Graphics for Win	339
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BS3253/5	★◆Excel for Windows 4 0	299 95
BS0704	Foxbase + Dev System 2 10	219
BS4065	◆FoxPro 2 0	515 95
BS7253/5	★Office 3 0 for Windows	485 95
BS2704	★◆Project for Windows 3.0	445 95
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WP0043/5	Word 5 5	209
WP0374	★◆Word for Windows 2 0	299 95
BS5324	★◆Microsoft Works for Windows	129.95
BS0173/5	Works 2 0	95
Multisoft Corporation		
UT2654	PC-Kwik Power Pak /Power Disk Bun.	82
Norton-Lambert		
CM0503/5	★Close-Up Dual Pack I/Win & DOS	119
Pacific Micro		
UT2903	Mac-In-DOS	59
Palo Alto		
BS6784	Business Plan Toolkit 4 0	95
PC Globe, Inc.		
BS1834	PC Globe 5 0	43
BS1844	PC USA 2 0	29
Peachtree Software		
FN0654	Peachtree Basic Accounting 6.0	75
Polaris		
BS2894	★PackRat 4.1	259
Power Up Software		
BS1654	Calendar Creator Plus 4 0	43
Qualitas		
UT0684	386MAX 6	61
Quarterdeck Office System		
BS1043/5	DESQview 386 2 4	129
EX1103/5	QEMM 386 6.0	61
Reference Software		
WP0334	Grammatik 5 for DOS	55
WP0514	★Grammatik 5 for Windows	55
Rupp Corp.		
UT2644	★FastLynx 2 0	99
Spinnaker Software		
BS1923/5	BetterWorking Eight-In-One	32
BS3604	★PFS:Window Works	95
Symantec		
UT2273/5	Norton AntiVirus 2.0	85
UT2183/5	★◆Norton Desktop for Windows	109 95
UT2313/5	◆Norton Util Advanced 6 01	115 95
UT2793/5	★Norton Backup 2 0 for DOS	99
CM0173/5	PC Anywhere 4 5 Host and Remote	119 95
BS4013/5	◆Q&A 4 0	255
BS3723/5	★On Target 1.0	255
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Timeslips		
BS6814	Timeslips 5	195.
Tool Technology Publishing		
UT2253	★WinTools	125
Touchstone		
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Triton		
CM0543/5	CQ/Session	99.
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WP0363/5	◆WordPerfect 5.1	269 95
WP1653/5	★◆WordPerfect 5.1 for Windows	289.95
XTree Company		
UT1874	XTree Gold 2.5	99

LANGUAGES

Borland International		
LN0563	Borland C++ 3.1	329
LN1664	★Object Vision 2 0 for Windows	105
LN0464	Turbo C++ 2nd Edition 3.0	74
LN0463/5	★Turbo C++ for Windows	105
Microsoft		
LN0543/5	◆C/C++ Compiler	299
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Aldus Publishing Showcase

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Publisher: Norton-Lambert
CM0503/5

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Publisher: Polaris PackRat 4.1 RS289+ $259.

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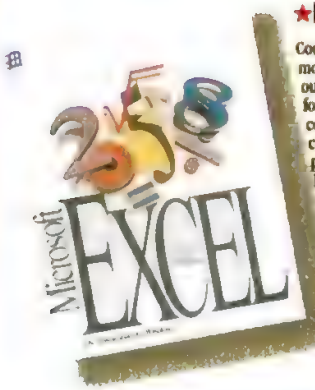
Manufacturer: The Software Toolworks
ED539+

$349



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Publisher: Microsoft

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Also available: *Microsoft Windows 3.1 Upgrade* UP0243/5 $39.
Publisher: Microsoft

Microsoft Windows 3.1
OP0163/5

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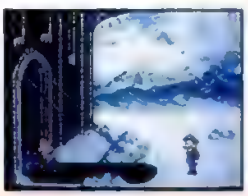
Publisher: New Vision Technologies, Inc. GR317+

$134

Mario is Missing!

Mario is Missing! is the exciting and fun filled game of exploration helping Luigi to foil Bowser's plans and find Mario - and learn about geography in the process. Bowser and the Koopa Critters have resumed their life of crime from a new castle in the frozen wasteland of Antarctica. Bowser has dispatched a network of larcenous Koopas to famous cities worldwide to steal important artifacts. Luigi's job is to clean up after the Koopa's, foil Bowser's plan before he runs out of time and most important, rescue his brother Mario.
Publisher: The Software Toolworks
EN3573/5

$39



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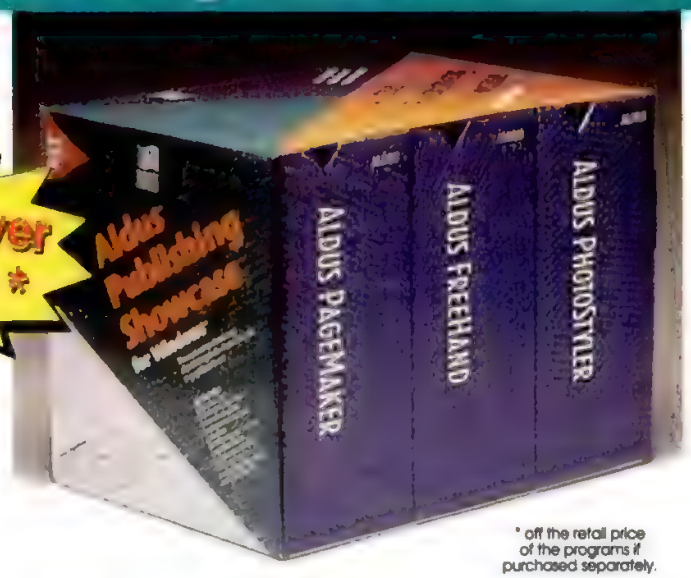

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- **Aldus Freehand**, a feature-rich design and illustration package, lets you illustrate your best ideas. Create your own ads, brochures, posters, diagrams, logos, and more.
- **Aldus PhotoStyler**, the first professional color image processor that runs under Windows, enables users to scan, enhance, edit, compose, and retouch 24-bit color, grayscale, and black-and-white images. Then export the enhanced images to other applications or print them from within the program.

All three programs in the Publishing Showcase look and feel the same, and work flawlessly with each other. Recommended: 386- or 486-based PC, 4 MB of RAM, 80 MB hard drive, a hi-res graphics adapter card, and a mouse.

GR5863 (3.5") GR5865 (5.25") *FaxFACTS 81720*

Publisher: Aldus
Suggested Retail: ~~$999~~ **$679**

Professional color image processing for Windows!

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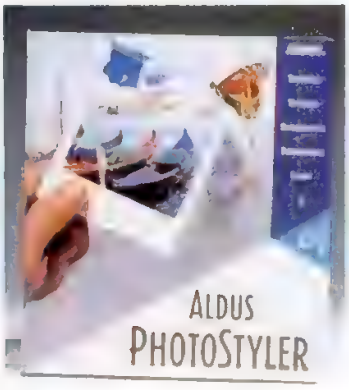
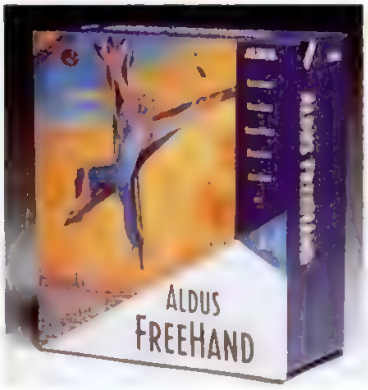


Aldus PhotoStyler enables users to scan, enhance, edit, compose, and retouch 24-bit color, grayscale, and black-and-white images and print them from the program. You can then export the enhanced images to your other applications for placement in all your documents, slides, and communications materials. Aldus PhotoStyler gives you the power and capability of a color prepress system with desktop convenience and economy. You can do retouching and color correction and produce quality color separations. Aldus PhotoStyler accepts direct input of images from scanner and video sources, thus saving you time. It lets you work in multiple windows, customize tools, and select from a dazzling palette of 16.8 million colors. Intuitive image and balance controls let you easily adjust an image's brightness, contrast, and color balance. And a toolbox full of powerful composition and masking features enable you to compose complex new images from multiple sources with hairline precision and control. Requires Microsoft Windows 3.0 or later, 286-based (or greater) IBM PC with 2 MB RAM, an EGA or 8514/A display (24-bit Super VGA color display recommended for professional-quality image enhancement), and a mouse.

GR5034 *FaxFACTS 80340*

Publisher Aldus
Suggested Retail. ~~$795~~ **$529**



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GR3043 (3.5") GR3045 (5.25") *FaxFACTS 80330*

Publisher: Aldus
Suggested Retail. ~~$595~~ **$389**

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SUITABILITY TO TASK

Amrel MLT486DXU33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

the factory handle processor upgrades. Our test system had a Cirrus Logic video chip set that can simultaneously support an external Super VGA monitor. The system contains 4MB of RAM (32MB is the maximum), a 130MB Toshiba hard disk, and a docking station.

Its nickel cadmium battery lasted 2 hours 8 minutes on our Battery Rundown test without power conservation (user-adjustable display and hard disk power-downs, plus system stand-by), and 2 hours 47 minutes on our ZDigit Rundown test with power conservation.

FACT FILE

Amrel MLT486DXU33 Notebook

Amrel Technology Inc., 9952 E. Baldwin Place, El Monte, CA 91731; 800-882-6735

List price (tested configuration): $2,799.
Tested configuration: 4MB RAM, Toshiba MK-2124FC 130MB hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive.
Options: 8MB RAM upgrade, $395; 486DX2/50 upgrade, $895; 486DX2/66 upgrade, $995; 80MB hard disk, $150 less; 180MB hard disk, $700; 2,400/9,600-bps V.32, V.42, MNP 5 fax modem, $195.
In Short: An average performer at a high price.
577 ON READER SERVICE CARD

The 9.5-inch-diagonal backlit TSTN (triple-supertwist nematic) Sharp LCD panel can handle up to VGA with 64 shades of gray. The 85-key keyboard has a responsive, springy feel. It has 12 half-height function keys; the cursor keys form a reclined L and unfortunately double as PgUp, PgDn, Home, and End. The recessed, built-in trackball and control keys are tiny and difficult to use because of their placement on the case front.

A send/receive fax modem and a 16550 UART are options. Amrel has a one-year parts-and-labor warranty and toll-free support. —*Robin B. Bornstein*

Aspen Computer Inc.

Aquiline 433

Ergo Computing Inc.

Ergo 486DX-33 NoteBrick II

Identical in many details, Aspen Computers' Aquiline 433 and the Ergo 486SX-33 NoteBrick II are too large to be notebooks and too small to be desktop replacements without their expansion stations.

Their 2.5- by 11- by 8.8-inch cases hold a screen that's only an average 8.5 inches diagonally. Oddly, the 2.2-pound nickel cadmium batteries lock on to the outside of each system; with a battery, each weighs a heavy 8.5 pounds.

Aspen's Aquiline 433 and the Ergo 486DX-33 NoteBrick II

The Aquiline's keyboard feels a little different than Ergo's—less key travel but more springy. It has the same well-marked function keys, and a simple usage menu is displayed after every boot. The case's front LEDs indicate sleep and turbo modes as well as hard disk usage.

The Ergo's distinguishing feature was its loudness: The 210MB Maxtor Cheyenne IDE hard disk sounds more like a small jet engine than a storage device. The Aspen uses a quieter, 245MB Seagate IDE hard disk.

Both portables use 486DX/33 CPUs (Ergo Computing also offers 486SX/25 and 486DX2/50 versions), and can support up to 16MB of RAM (our test units came with 4MB). The Cirrus chip sets and 256K of video memory drive Sanyo TSTN backlit LCD panels capable of 32 shades of gray; the two units can also run an external VGA monitor with 16 colors. (With its optional docking station, the Aspen can run a 1,024-by-768 monitor.) The Aspen and Ergo also include DOS 5.0 and Microsoft Windows 3.1. Neither company offers an internal modem, but Ergo's optional docking station can hold one.

On our benchmark tests, they performed almost identically: average performance for their class, except for their disk scores: The Aquiline's Seagate hard disk outperformed the Ergo's Maxtor Cheyenne unit under both DOS and Windows. Video scores were far below

SUITABILITY TO TASK

Aquiline 433

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

SUITABILITY TO TASK

Ergo 486DX-33 NoteBrick II

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Aquiline 433

Aspen Computer Inc., 5813 Main St. #10, Buffalo, NY 14221; 800-370-3322

List price (tested configuration): $2,695.
Tested configuration: 4MB DRAM, Seagate ST3283A 245MB IDE hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, Sanyo LCM 5483 TSTN backlit LCD screen.
Options: 8MB RAM upgrade, $295; 16MB upgrade, $575; docking station, $295; 486DX2/50 upgrade, $500; 2,400-bps/9,600-bps MNP 5 V.42 fax modem, $195.
In short: The Aquiline is too big to be easily portable and lacks internal modem options.
578 ON READER SERVICE CARD

FACT FILE

Ergo 486DX-33 NoteBrick II

Ergo Computing Inc., One Intercontinental Way, Peabody, MA 01960; 800-633-1925, 508-535-7510; fax, 508-535-7512

List price (tested configuration): $3,695.
Tested configuration: 4MB DRAM, Maxtor Cheyenne 7213AT 210MB IDE hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive.
Options: 8MB RAM upgrade, $300; 16MB RAM upgrade, $600; math coprocessor, $259; docking station, $295; 9,600-bps send/receive fax/2,400-bps modem, $249; 2,400-bps internal modem, $149.
In short: The unit loses points because of its bulk.
579 ON READER SERVICE CARD

average under DOS and Windows. Battery tests reflected their lack of power-saving features. Both units lasted 2 hours 5 minutes on our ZDigit test with power conservation. On our Battery Rundown test without power conservation, the Aquiline lasted only 1 hour 45 minutes, and the Ergo barely kept up, at 1 hour 40 minutes.

Service and support is one area where the two companies diverge: The Ergo carries a one-year parts-and-labor warranty and a 30-day money-back guarantee; Aspen backs its portable with toll-call technical support and a service plan for which you ship the broken unit to the manufacturer and receive a loaner.—*OR*

Austin Computer Systems Inc.

Austin 386/SXL-25 Notebook

The $1,890 Austin 386/SXL-25 Notebook combines easy upgrades with a solid battery life. But its relatively weak video performance is a drawback.

The Austin measures 2 by 10.9 by 8.4

The Austin 386/SXL-25 Notebook

SUITABILITY TO TASK

Austin 386/SXL-25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Austin 386/SXL-25 Notebook

Austin Computer Systems Inc., 10300 Metric Blvd., Austin, TX 78758; 800-752-1577

List price (tested configuration): $1,890
Tested configuration: 4MB RAM, 60MB Seagate ST9077A hard disk, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive.
Options: 2MB RAM upgrade, $125; 6MB RAM upgrade, $375; 120MB hard disk, $300; math coprocessor, $139; internal 9,600/4,800-/2,400-bps send/receive fax modem, $149.
In short: This product has a long battery life but is impaired by poor video performance.
580 ON READER SERVICE CARD

inches and weighs 6.2 pounds with the nickel cadmium battery; the 1.8-pound AC adapter brings the travel weight to 8 pounds. Our test unit came with a 60MB Seagate IDE hard disk, 4MB of RAM, DOS 5.0, Microsoft Windows 3.1, PFS: WindowWorks, and data compression software. The 9.5-inch-diagonal Seiko TSTN (triple-supertwist nematic) edgelit screen is controlled by a Cirrus 610/620 chip set with 256K of VRAM. This portable can use an external Super VGA monitor at 16 colors, but not simultaneously.

A metal flap on the case's bottom pries open easily for RAM upgrades (up to 8MB). The Austin's processor and memory scores were strong, although its DOSmark score was low. Its DOS video score was average, but in the Am386SXL/25 processor class the Austin's Graphics Winmark score was last.

Without power conservation, the Austin showed its worth by lasting 3 hours 23 minutes. On our ZDigit Rundown test with power conservation (display, hard disk, and CPU power-downs), it lasted 4 hours 42 minutes.

The springy, 79-key keyboard has its cursor keys in an inverted-T layout, but unfortunately they double as PgUp, PgDn, Home, and End keys. The trackball (located above the keyboard) is tiny, light, and awkward to use.

Austin offers 24-hour, 7-day-a-week technical support via a toll-free number and a BBS.—*Catherine Kunkemueller*

AVI Systems Inc.

AVI ANB3-386SXL-25

The $2,599 AVI ANB3-386SXL-25 may seem expensive for a Am386SXL/25 system, but it had a 180MB hard disk and can simultaneously run an external VGA monitor at 16 colors.

The AVI's solidly constructed, dark blue case measures 1.8 by 11 by 9 inches and weighs 5.4 pounds with the nickel cadmium battery; the AC adapter adds another 1.4 pounds. Our test unit housed

The AVI ANB3-386SXL-25

an 180MB Areal IDE hard disk with a 32K cache, a 1.44MB internal floppy disk drive, and 4MB of 70-ns proprietary RAM (8MB is the maximum). A Cirrus chip set with 256K of VRAM controls the 9.5-inch-diagonal Sharp passive-matrix TFT (thin-film technology) edgelit screen.

On our tests, the AVI snared a place near the top of its processor class, with its disk, Disk Winmark, and DOS video results beating some of the tested 486SX/25 systems. Its battery life was almost 2 hours without power conservation and

SUITABILITY TO TASK

AVI ANB3-386SXL-25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

▶ SUMMARY OF FEATURES

Monochrome Portables

Products listed in alphabetical order

■ = YES □ = NO

	AcerAnyWare V386SL	ALR Ranger M425-120	ALR Ranger M425s-120	ALR Ranger MC425-120	ALR Ranger MC425s-120	Altima 325 80386SL
List price (*PC Magazine* configuration)	$1,999.00	$3,390.00	$2,890.00	$4,290.00	$3,890.00	$2,727.00
Processor type and speed	Intel 386SL/25	Intel 486DX/25	Intel 486SX/25	Intel 486DX/25	Intel 486SX/25	Intel 386SL/25
Hard disk capacity	81MB	120MB	120MB	120MB	120MB	80MB
Microsoft Windows 3.1	■	■	■	■	■	■
Dealers/direct-distribution channel	■□	■■	■■	■■	■■	■□
Dimensions (HWD, in inches)	2 x 11.4 x 8.5	2.3 x 11.8 x 8.5	2.3 x 11.8 x 8.5	2.3 x 11.8 x 8.5	2.3 x 11.8 x 8.5	1.6 x 11 x 8.5
Weight/travel weight (pounds)	5.9, 7.2	7.4, 8.6	7.7, 9	7.5, 9	7.8, 9	5.9, 7.6
Display area (H x W, in inches)	6 x 7.8	5.3 x 6.8	5.3 x 6.8	5.3 x 6.8	5.3 x 6.8	5.8 x 7.7
Keys: total, function, cursor	82, 12, 8	82, 10, 8	82, 10, 8	82, 10, 8	82, 10, 8	84, 10, 8
Motherboard						
Motherboard manufacturer	Acer	ALR	ALR	ALR	ALR	Twinhead
Chip set manufacturer	Intel	WD	WD	WD	WD	Intel
BIOS version (or date)	Acer (7/24/92)	Phoenix (7/6/92)	Phoenix (4/19/90)	Phoenix (7/6/92)	Phoenix (7/6/92)	Quadtel (4/22/92)
Setup in ROM/Password in ROM	■■	■■	■■	■■	■■	■■
System shadowing/Video shadowing	■■	□■	□■	□■	■■	■■
Memory and Disk Drives						
Installable RAM	4MB–12MB	4MB–16MB	4MB–16MB	4MB–16MB	4MB–16MB	2MB–6MB
User-installable	■	■	■	■	■	■
External processor RAM cache	64K	None	None	None	None	64K
Available hard disk sizes	80MB, 120MB	60MB, 80MB, 120MB	60MB, 80MB, 120MB	80MB, 120MB	60MB, 80MB, 120MB	80MB, 120MB
I/O and Expansion						
Parallel, serial, mouse ports	1, 2, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
Proprietary expansion port	■	□	□	□	□	■
PCMCIA slot	■	□	□	□	□	□
Expansion unit	$699	□	□	□	□	$599
Internal modem options	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send-only fax, 2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send-only fax, 2,400/9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send-only fax, 2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send-only fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
Video						
Screen manufacturer	Sharp	Sharp	Sharp	Sharp	Sharp	Sharp
Maximum shades of gray	32	32	32	16	16	64
Video chip set manufacturer	Cirrus	WD	WD	*	*	Cirrus
Simultaneous external display	■	□	□	□	□	■
Maximum external resolution	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600
Maximum external colors	16	256	256	256	256	16
AC Adapter and Battery						
AC adapter size (inches)	1.5 x 6 x 1.9	2 x 3.5 x 5.7	2 x 3.5 x 5.8	2 x 3.5 x 5.8	2 x 3.5 x 5.8	2 x 6.5 x 3.1
Rated battery life (hours)	4.5	3.5	3.5	3.5	3.5	6
ZDigit, battery rundowns (hr:min)	3:02, 1:56	7:41, 2:26	6:18, 2:32	4:27, 2:06	3:44, 1:46	3:01, 2:44
Charge time while on, off (hours)	N/A, 2	2.5, 2	2.5, 2	2.5, 2	2.5, 2	2, 2
Battery weight, amp/hour rating	0.9 lbs, 3.9Ah	1.8 lbs, 1.6Ah	1.8 lbs, 1.6Ah	1.8 lbs, 1.6Ah	1.8 lbs, 1.6Ah	1.3 lbs, 1Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■□	■■	■■	■■	■■	■■
Standby/Hibernation	■■	□□	□□	□□	□□	■■

* This system has a color display that reproduces 16 colors
N/A—Not applicable: The product does not have this feature
ACC—ACC Micro Electronics, C&T—Chips & Technologies Inc., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital Corp

	Altima 433 80486DX	American Mitac 3025F	American Mitac 3027F	Amrel MLT486DXU33	Aspen Aquiline 433	Austin 386/SXL-25 Notebook	AVI ANB3-386SXL-25	BLK 386SL/25NBF
	$3,798.00	$1,899.00	$2,019.00	$2,799.00	$2,695.00	$1,890.00	$2,599.00	$1,795.00
	Intel 486DX/33	Intel 386SX/25	Intel 386SL/25	Intel 486DX/33	Intel 486DX/33	AMD Am386SXL/25	AMD Am386SXL/25	Intel 386SL/25
	120MB	80MB	81MB	130MB	245MB	60MB	180MB	80MB
	■	■	■	■	■	■	□	■
	■□	■■	■■	■■	■■	■■	■□	■■
	1.6 x 11 x 8.5	2.5 x 11.5 x 8.5	2 x 11 x 9.2	2.5 x 11.5 x 8.5	2.5 x 11 x 8 8	2 x 10.9 x 8.4	1.8 x 11 x 9	1.5 x 11.3 x 8.5
	6.1, 7.7	6.9, 8.8	6.3, 7.7	7.3, 9	8.5, 10.2	6.2, 8	5 4, 7.1	5.5, 6.7
	5.8 x 7.7	5.8 x 7.5	5.2 x 7	6 x 7.1	5 x 6.8	5.6 x 7.6	5.8 x 7.8	5.8 x 7.8
	84, 10, 8	82, 12, 4	84, 12, 8	85, 12, 4	82, 10, 8	79, 10, 4	84, 10, 8	86, 10, 8
	Twinhead	American Mitac	American Mitac	Amrel	NTC	Austin	AVI	Chaplet
	ACC	Headland	Intel	ACC	NTC	VLSI	Acer	ACC
	Phoenix (5/21/92)	Phoenix (4/19/90)	Phoenix (11/29/91)	AMI (1/7/92)	Award 3.03	Phoenix (4/9/90)	AMI (5/5/91)	Quadtel (6/22/92)
	■□	■□	■■	■■	■□	■□	■■	■■
	■■	■■	■■	□■	■■	□■	□■	■■
	4MB–20MB	1MB–6MB	2MB–10MB	4MB–32MB	2MB–16MB	2MB–8MB	2MB–8MB	4MB–8MB
	■	□	□	■	■	■	■	■
	None	None	16K	128K	None	None	None	32K
	120MB	60MB, 80MB	60MB, 80MB, 120MB	80MB, 130MB, 200MB	120MB, 170MB, 240MB	60MB, 120MB	60MB, 80MB, 130MB, 180MB	60MB, 80MB, 120MB
	1, 1, 1	1, 1, 0	1, 1, 1	1, 1, 0	1, 2, 0	1, 1, 0	1, 2, 0	1, 2, 0
	■	■	■	■	■	□	□	□
	□	□	□	□	□	□	□	□
	$599	□	□	$695	$295	□	□	□
	2,400-bps/ 9,600-bps MNP 5 fax, 2,400-bps/ 4,800-bps send-only fax	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps send-only fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	None	2,400-bps/ 9,600-bps send-only fax, 4,800-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/recieve fax	None
	Sharp	Sharp	Sharp	Sharp	Sanyo	Seiko	Sharp	Sharp
	64	32	32	64	32	32	32	64
	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus
	■	□	□	■	□	□	■	■
	800 x 600	800 x 600	800 x 600	800 x 600	640 x 480	800 x 600	800 x 600	800 x 600
	16	16	16	16	256	16	16	256
	1.9 x 6.5 x 4.3	2.3 x 9.3 x 1.3	2 2 x 5 5 x 3.2	2 3 x 3 x 6.5	2.3 x 6.8 x 3	1.6 x 3.1 x 5.7	2 x 6.5 x 3	1.8 x 2.5 x 6
	2.5	3	3	2	2	4	2.5	5.5
	2:47, 2:12	3:01, 2:31	3.01, 2:20	2.47, 2.08	2.05, 1:45	4.42, 3.23	3:02, 1:58	2:32, 1:15
	2, 2	10, 2	14, 2	3, 2	8, 2	6, 2	3, 3	2, 2
	1.3 lbs, 1Ah	1.2 lbs, 1.4Ah	1.1 lbs, 2.8Ah	1.3 lbs, 2Ah	2.2 lbs, 2.6Ah	1.3 lbs, 1.3Ah	0 8 lbs, 2.4Ah	0.7 lbs, 1.5Ah
	■■	■□	■■	■■	■■	■■	■■	■□
	■■	■□	■■	■□	□□	■■	■□	■■
	■■	■□	■□	■□	□□	□□	■□	■■

CONTINUES

AFTER YEARS OF LOSING MARKET SHARE TO DELL, IT SEEMS IBM AND COMPAQ WANT TO PLAY HARDBALL.

CUSTOMER SATISFACTION SURVEY

Source: Reliability Ratings™ - 1992 PC Vendor Survey*

SERVICE		TECHNICAL SUPPORT		PRICE		RELIABILITY	
1. DELL	(8.63)	**1. DELL**	(8.09)	**1. DELL**	(8.82)	**1. DELL**	(8.96)
2. APPLE	(8.06)	2. IBM	(7.99)	2. COMPAQ	(6.62)	2. COMPAQ	(8.95)
3. IBM	(8.01)	3. APPLE	(7.72)	3. APPLE	(6.58)	3. APPLE	(8.58)
4. COMPAQ	(8.00)	4. COMPAQ	(7.71)	4. IBM	(6.01)	4. IBM	(8.54)

*Based on customer ratings from a sample of the 500 largest corporate PC sites in America.

What can we say?

Our competitors keep throwing their best stuff at us, and we keep hitting it out of the park.

It's not that they aren't trying. It's just that they're trying to play the game we invented.

Suddenly they're all out there hustling to lower their prices, set up direct support lines, and upgrade customer service. Stuff that we've been doing for years.

And as customer satisfaction surveys show, we're just plain better at it. In the most recent Reliability

SYSTEM	MICROPROCESSOR	MEMORY	HARD DRIVE	MONITOR	PRICE
325SX DESKTOP	i386™ SX, 25 MHz	2 MB	80 MB	VGA 800 COLOR	$1,149
486P DESKTOP	i486™ SX, 25 MHz	4 MB	120 MB	SUPER VGA COLOR	$1,799
486P DESKTOP	i486 DX, 33 MHz	4 MB	170 MB	ULTRASCAN™ 14C	$2,299
486D DESKTOP	i486 DX2, 50 MHz	4 MB	170 MB	ULTRASCAN 14C	$2,749
486D DESKTOP	i486 DX2, 66 MHz	8 MB	230 MB	ULTRASCAN 15VS	$3,349
325NC COLOR NOTEBOOK	i386 SL, 25 MHz	4 MB	60 MB	VGA COLOR LCD	$2,799

All systems include MS-DOS® 5.0, and one floppy drive. Dell systems are custom configured. Systems listed above represent a sampling of configurations available.

intel inside

Survey was conducted by Reliability Ratings, Needham, MA. The data is quoted from a publicly available 40 page report. Reliability Ratings, the research company, is not affiliated with Dell Computer Corp. and does not endorse its products.

**Guarantees available in USA only for registered owners of Dell Performance Series systems purchased after 7/1/92. For a complete copy, please call our TechFax™ line at 1-800-950-1329 or write Dell USA L.P., 9505 Arboretum Blvd., Austin TX 78759-7299. Attention Guarantees. †Service provided by BancTec Service Corp. On-site service may not be available in certain remote areas. i386, i486 and the Intel Inside logo are trademarks of Intel Corp. MS-DOS is a registered trademark of Microsoft Corp. Dell disclaims proprietary interest in the marks and names of others.* *©1992 Dell Computer Corp. All rights reserved.*

SO FAR, WE'RE AHEAD EIGHT TO NOTHING.

UPGRADEABILITY		FUNCTIONALITY		MONITOR		OVERALL SATISFACTION	
1. DELL	(8.52)	**1. DELL**	(8.73)	**1. DELL**	(8.31)	**1. DELL**	(8.77)
2. APPLE	(7.64)	2. COMPAQ	(8.45)	2. APPLE	(8.08)	2. COMPAQ	(8.45)
3. COMPAQ	(7.48)	3. APPLE	(8.40)	3. COMPAQ	(7.60)	3. APPLE	(8.14)
4. IBM	(6.91)	4. IBM	(7.96)	4. IBM	(7.38)	4. IBM	(7.89)

Ratings survey drawn from the 500 largest corporate PC sites in the country, Dell took first in all eight categories.

We also came out on top in eight separate *PC Week* customer satisfaction polls. An unprecedented feat.

So we intend to stick with our game plan. Low prices. Durable computers. And the best service anywhere.

We'll also continue to keep throwing the competition some major curveballs.

Like introducing the only written Compatibility, Service[1] and Response Guarantees in the industry.*

If you want a computer from a company that, time and again, has been proven to be number one, give us a call.

You'll soon see why we're in a league of our own.

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▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Chaplet 386 SL25 Notebook	Compaq Contura 3/20	Compaq Contura 3/25	Compaq LTE Lite/25E (PC Editors' Choice)	CompuAdd Express 425CXL-80	Compudyne Slimnote 386SL/25-80
List price (*PC Magazine* configuration)	$2,295.00	$1,892.00	$2,074.00	Info not available	$2,245.00	$1,799.00
Processor type and speed	Intel 386SL/25	Intel 386SL/20	Intel 386SX/25	Intel 386SL/25	Cyrix CX486SLC/25	Intel 386SL/25
Hard disk capacity	120MB	84MB	60MB	80MB	80MB	80MB
Microsoft Windows 3.1	□	□	□	■	■	■
Dealers/direct-distribution channel	■□	■□	■□	■□	□■	■■
Dimensions (HWD, in inches)	1.8 x 11.3 x 8.5	2 x 11.5 x 9	2 x 11 x 9	2 x 11 x 8.5	2 x 11 x 8.5	11.6 x 11 x 8.5
Weight/travel weight (pounds)	5.2, 6.9	6.2, 7.6	6.2, 7.6	6.4, 8.4	5.2, 6.9	5.9, 7.6
Display area (H x W, in inches)	6 x 8	5.8 x 7.5	5.8 x 7.5	5.3 x 6.8	5.8 x 7.8	5.8 x 7.7
Keys: total, function, cursor	86, 10, 8	79, 10, 8	79, 10, 8	80, 10, 4	86, 12, 8	84, 10, 8
Motherboard						
Motherboard manufacturer	Chaplet	Compaq	Compaq	Compaq	TI	Twinhead
Chip set manufacturer	Intel	Intel	Intel	Intel	WD	Intel
BIOS version (or date)	System Soft (7/15/92)	Compaq (6/2/92)	Compaq (6/2/92)	Compaq (9/23/92)	Phoenix (4/19/90)	System Soft (4/22/92)
Setup in ROM/Password in ROM	■□	■■	■■	■■	■□	■■
System shadowing/Video shadowing	■■	■□	■□	■■	□■	■■
Memory and Disk Drives						
Installable RAM	2MB–8MB	2MB–10MB	4MB–12MB	4MB–20MB	1MB–16MB	2MB–6MB
User-installable	■	■	■	■	■	■
External processor RAM cache	16K	None	None	64K	None	64K
Available hard disk sizes	60MB, 80MB, 120MB	40MB, 84MB	60MB, 120MB	84MB, 120MB	80MB, 120MB	80MB
I/O and Expansion						
Parallel, serial, mouse ports	1, 2, 0	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
Proprietary expansion port	□	□	□	■	□	■
PCMCIA slot	□	□	□	□	□	□
Expansion unit	□	□	□	$699	□	□
Internal modem options	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
Video						
Screen manufacturer	Citizen	Compaq	Compaq	Compaq	Sharp	Sharp
Maximum shades of gray	64	64	64	16	64	64
Video chip set manufacturer	Cirrus	Compaq	Compaq	Compaq	WD	Cirrus
Simultaneous external display	■	□	□	■	□	■
Maximum external resolution	800 x 600	800 x 600	800 x 600	640 x 480	640 x 480	800 x 600
Maximum external colors	256	16	16	256	16	16
AC Adapter and Battery						
AC adapter size (inches)	1.5 x 6 x 4.5	1.5 x 5.4 x 3.4	1.5 x 5.3 x 3.3	1.4 x 5.3 x 3.3	3.3 x 2.6 x 2.2	2 x 6.5 x 3.1
Rated battery life (hours)	2	3.5	3.5	3	2	3.5
ZDigit, battery rundowns (hr:min)	1:51, 1:23	4.53, 2:28	4:11, 2.15	4 11, 2:38	2.48, 2:09	3:44, 2:20
Charge time while on, off (hours)	2, 2	1.5, 1	1.5, 1	1.5, 1	7, 1.5	4, 2
Battery weight, amp/hour rating	0 7 lbs, 1.5Ah	1.1 lbs, 3Ah	1.1 lbs, 3Ah	1.2 lbs, 2.2Ah	0 7 lbs, 1.4Ah	1.3 lbs, 1Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	■■	■■	■■	■■	■■
Standby/Hibernation	■■	■■	■■	■■	■■	■□

** The unit we tested had a 120MB hard disk, which is not currently available
N/A—Not applicable The product does not have this feature
ACC—ACC Micro Electronics, C&T—Chips & Technologies Inc , TI—Texas Instruments Inc , VLSI—VLSI Technology Inc , WD—Western Digital Corp

	Compudyne Slimnote 486SX/25-80	Digital DECpc 325p	Dell Dimension NL20	Dell System 320SLi	Dell System 325N	DTK Grafika 3N	Ergo 486DX-33 NoteBrick II	Everex Carrier SL/25
	$2,199.00	$3,295.00	$1,748.00	$2,547.00	$2,249.00	$1,922.00	$3,695.00	$2,438.00
	Intel 486SX/25	Intel 386SL/25	Intel 386SL/20	Intel 386SL/20	Intel 386SL/25	AMD Am386SXL/25	Intel 486DX/33	Intel 386SL/25
	80MB	125MB	60MB	60MB	60MB	120MB **	210MB	81MB
	■	■	■	■	■	■	■	■
	■■	■■	■■	■■	■■	■□	■■	■□
	11.6 x 11 x 8.5	1.8 x 11.7 x 8.5	1.8 x 11 x 8.3	1.3 x 11 x 7.8	2.3 x 11 x 8.5	2 x 11.5 x 8.2	2.5 x 11 x 8.8	2 x 11 x 8.5
	6, 6.6	5.9, 7.2	6.1, 7.6	3.8, 4.8	6.4, 7.4	6.4, 7.6	8.5, 10.2	6, 7.5
	5.8 x 7.7	6 x 8	5.1 x 6.8	5.5 x 7.7	5.8 x 7.5	5.5 x 7	5 x 6.8	5.2 x 7
	84, 10, 8	84, 12, 8	85, 12, 8	85, 12, 8	85, 12, 8	85, 12, 8	82, 10, 8	81, 12, 0
	Twinhead	Matsushita	Dell	Dell	Dell	SOTEC	NTC	Everex
	ACC	C&T	Intel	Intel	Intel	VLSI	ETEQ	Intel
	Phoenix (5/12/92)	Phoenix (5/13/92)	Quadtel/Phoenix A03	Phoenix (9/6/92)	Phoenix (7/28/92)	AMI (3/20/92)	Award 3.03	AMI/Everex (6/23/92)
	■□	□□	■■	■■	■■	■□	■□	■■
	■■	□□	■■	■■	■■	□□	■■	■■
	4MB–20MB	2MB–8MB	2MB–8MB	2MB–10MB	4MB–12MB	1MB–5MB	1MB–16MB	2MB–20MB
	□	■	■	■	■	■	■	■
	None	16K	None	None	64K	None	None	64K
	80MB, 120MB	80MB, 120MB	40MB, 60MB	60MB, 80MB, 120MB	60MB, 80MB, 120MB	60MB, 80MB, 120MB	120MB, 210MB, 340MB	85MB, 120MB, 180MB
	1, 1, 1	1, 1, 0	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 2, 0	1, 1, 0
	■	■	□	□	□	□	■	□
	□	□	□	■	□	□	□	□
	□	$599	□	□	□	□	$295	□
	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send-only fax	2,400-bps	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps send/receive fax	2,400-bps	2,400-bps/ 9,600-bps send-only fax
	Sharp	Sharp	Sharp	Sharp	Sharp	Epson	Sanyo	Sharp
	64	32	32	64	32	16	32	16
	Cirrus	Cirrus	Cirrus	Cirrus	WD	WD	Cirrus	Cirrus
	■	■	□	□	□	□	□	■
	800 x 600	640 x 480	800 x 600	800 x 600	800 x 600	640 x 480	640 x 480	800 x 600
	16	16	16	16	16	16	256	16
	1.9 x 6.5 x 3.1	1.6 x 2.5 x 5.5	1.8 x 3 x 6.1	1.8 x 2.5 x 4.6	1.5 x 3.2 x 5.5	2.5 x 5 x 1.5	1.6 x 3.1 x 5.7	1.7 x 5.7 x 2.5
	2.5	4	2.5	2.5	3	1	2	1.5
	3:30, 2:27	3:30, 2:31	3:30, 3:12	N/A, 3:08	5:07, 3:41	3:29, 2:03	2:05, 1:40	2:21, 1:56
	4, 2	5, 2	10, 2.5	6, 2	N/A, 3.5	8.5, 2	2, 2	1, 1
	1.3 lbs, 1Ah	1 lb, 0.9Ah	1.5 lbs, 1.3Ah	0.7 lbs, 2Ah	1.6 lbs, 2Ah	0.9 lbs, 1.5Ah	2.2 lbs, 2.5Ah	0.8 lbs, 2.2Ah
	■■	□■	■■	■■	■■	■■	■■	■■
	■■	■■	□■	■■	■■	■□	□□	■□
	■□	■□	■■	■■	■■	■□	□□	■■

CONTINUES

▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	GRiD 1660	GRiD 1755 486SLC	GRiD Convertible	IBM PS/note N45sl	Identity 386SXL-25 Notebook Computer	Jetta Jetbook 486DX/33
List price (*PC Magazine* configuration)	$3,220.00	$3,020.00	$3,400.00	$2,045.00	$2,595.00	$2,598.00
Processor type and speed	Intel 386SL/25	Cyrix CX486SLC/25	Intel 386SL/25	Intel 386SL/25	AMD Am386SXL/25	Intel 486DX/33
Hard disk capacity	120MB	80MB	120MB	80MB	210MB	85MB
Microsoft Windows 3.1	■	■	■	□	■	□
Dealers/direct-distribution channel	■□	■□	■□	■■	■□	■□
Dimensions (HWD, in inches)	1.8 x 11.6 x 8.5	1.5 x 12.3 x 10	1.6 x 11.5 x 9.4	2 x 12.3 x 8.3	2.3 x 11 x 8.6	2.3 x 11.5 x 9
Weight/travel weight (pounds)	5.9, 7.1	6.4, 7.7	5.5, 7.2	7, 8.9	5.7, 8	6.6, 8.1
Display area (H x W, in inches)	6 x 8	5.1 x 7	6 x 7.6	5.8 x 7.6	5 x 6.9	5.8 x 7.8
Keys: total, function, cursor	84, 12, 8	84, 12, 8	79, 10, 8	82, 12, 8	84, 12, 8	84, 12, 8
Motherboard						
Motherboard manufacturer	Matsushita	Matsushita	Tandy	IBM	ARC	Jetta
Chip set manufacturer	C&T	Headland	Intel	Intel	AMD	C&T
BIOS version (or date)	Phoenix (4/7/92)	Phoenix (5/22/92)	Phoenix (6/12/92)	ZDS (2/14/92)	Phoenix (4/19/90)	AMI (7/10/92)
Setup in ROM/Password in ROM	■■	■■	■■	■■	■■	■■
System shadowing/Video shadowing	■■	■■	□□	□■	■■	■■
Memory and Disk Drives						
Installable RAM	2MB–20MB	2MB–8MB	2MB–8MB	2MB–8MB	1MB–8MB	4MB–32MB
User-installable	■	■	■	■	■	□
External processor RAM cache	64K	1MB	None	64K	None	32K
Available hard disk sizes	125MB	80MB	120MB	80MB, 120MB	500MB	80MB, 125MB
I/O and Expansion						
Parallel, serial, mouse ports	1, 1, 1	1, 1, 1	1, 1, 0	1, 1, 1	1, 2, 0	1, 2, 1
Proprietary expansion port	□	□	□	□	□	■
PCMCIA slot	□	□	□	□	□	□
Expansion unit	□	□	□	□	□	$395
Internal modem options	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send/receive fax, 14,400-bps send/receive fax	2,400-bps/ 9,600-bps send/receive fax	None	2,400-bps/ 9,600-bps send/receive fax
Video						
Screen manufacturer	Sharp	Sharp	Sharp	Epson	Sanyo	Hitachi
Maximum shades of gray	64	64	64	32	32	64
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	WD	Cirrus	Cirrus
Simultaneous external display	■	■	■	□	□	■
Maximum external resolution	640 x 480	640 x 480	640 x 480	640 x 480	800 x 600	800 x 600
Maximum external colors	16	16	16	256	16	256
AC Adapter and Battery						
AC adapter size (inches)	1.6 x 2.5 x 5.5	1.8 x 2.8 x 5.3	1.5 x 3 x 7.8	2 x 3.4 x 6.6	1.3 x 3.5 x 5	1.8 x 6 x 2.5
Rated battery life (hours)	3	2.5	3	3	2.5	3.5
ZDigit, battery rundowns (hr:min)	4:11, 2:09	2:47, 1:53	1:39, 1:21	3:44, 2:57	2:34, 1.45	3:15, 2:54
Charge time while on, off (hours)	5, 2	5, 2	1.5, 1.5	3, 1.5	8, 4	2, 2
Battery weight, amp/hour rating	0.9 lbs, 0.9Ah	0.7 lbs, 1.4Ah	0.8 lbs, 1.3Ah	1.4 lbs, 1.3Ah	1 lb, 2.8Ah	1.8 lbs, 2Ah
Display/hard disk power-down	□■	■■	■■	■■	■■	■■
CPU/peripherals power-down	□■	□■	□■	□■	■■	■□
Standby/Hibernation	■□	■□	□□	■■	■□	■□

N/A—Not applicable The product does not have this feature
ACC—ACC Micro Electronics, C&T—Chips & Technologies Inc , TI—Texas Instruments Inc , VLSI—VLSI Technology Inc , WD—Western Digita Corp

	Keynote 386SX-25	Keynote 486SLC	Leading Edge N3/SL25 Plus	Librex R386SL	Librex T386SX	Lightning Thundernote 486DX/33	Matrix 486SX-25Mhz Notebook	Micro Express NB486DX
	$1,595.00	$1,875.00	$2,499.00	$2,499.00	$2,499.00	$2,280.00	$1,995.00	$3,049.00
	AMD Am386SXL/25	Cyrix CX486SLC/25	Intel 386SL/25	Intel 386SL/25	Intel 386SX/20	Intel 486DX/33	Intel 486SX/25	Intel 486DX/33
	85MB	85MB	85MB	80MB	40MB	130MB	80MB	120MB
	■	■	■	■	□	■	□	■
	■■	■■	■□	■□	■□	■■	■□	□■
	2 x 11.8 x 8.3	1.9 x 11.8 x 8.3	2 x 13.5 x 8.6	2 x 11.7 x 8.5	1.5 x 11.7 x 8.5	1 8 x 11 x 8.8	2 x 11 x 8 8	1.5 x 11.5 x 8.5
	7.1, 8.4	6.6, 8.3	6.8, 8.1	6.7, 7.9	5.3, 7.6	4.9, 8	6.8, 8	7.3, 9
	5.8 x 7.5	5.8 x 7.5	5.8 x 7.6	5.8 x 7.6	5.8 x 7.6	5.8 x 7.5	5.7 x 7.6	6 x 7.8
	83, 10, 8	83, 10, 8	100, 12, 8	85, 12, 8	82, 12, 4	84, 10, 8	82, 12, 8	85, 12, 4
	Chicony	Chicony	Leading Edge	VLSI	Nippon Steel	Twinhead	Quanta	Micro Express
	VLSI	WD	Intel	VLSI	VLSI	ACC	NTC/ACC	ACC
	AMI (5/19/92)	AMI (5/5/91)	Phoenix (4/19/90)	AMI (7/20/92)	Award (6/9/92)	Phoenix (8/12/92)	Award (7/8/92)	AMI (1/7/92)
	■■	■■	■■	■■	■■	■■	■■	■■
	■■	■■	□■	■■	■■	■■	■■	■■
	1MB–5MB	2MB–10MB	2MB–8MB	2MB–20MB	4MB–12MB	4MB–20MB	4MB–20MB	4MB–32MB
	■	■	■	■	■	■	■	□
	None	None	32K	None	None	None	None	128K
	60MB	85MB, 125MB	80MB, 120MB	80MB, 120MB	40MB, 80MB	80MB, 124MB, 180MB	80MB, 120MB	120MB
	1, 2, 0	1, 2, 0	1, 1, 1	1, 1, 0	1, 1, 1	1, 1, 0	1, 1, 1	1, 1, 0
	□	■	□	□	□	■	■	■
	□	□	□	□	■	□	□	□
	□	$270	□	□	□	□	□	□
	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 4,800-bps MNP 5 send-only fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	None	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps send/receive fax	Included
	Sanyo	Sanyo	Hitachi	Seiko	Sanyo	Sharp	Sharp	Panasonic
	16	16	64	64	64	64	64	64
	Cirrus	Cirrus	Cirrus	WD	Cirrus	Cirrus	Cirrus	Cirrus
	□	□	□	□	■	■	■	■
	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600
	16	16	16	16	16	16	256	256
	1.4 x 6 x 1.3	1.5 x 6.5 x 3.3	1.8 x 5.7 x 2.8	1.7 x 2.3 x 5	1.5 x 2.5 x 5.5	1.8 x 6.8 x 3.3	1.8 x 4.5 x 2.9	2.8 x 6.5 x 3
	2	3	2.5	3	2.5	3	2	3
	3 02, 1:58	N/A, 2:07	1:51, 1:22	2:48, 1:35	3:30, 2:23	2:05, 1:46	4:12, 2:01	3.01, 2:33
	4, 2	2, 2	3, 1.5	5, 1.8	8, 2	2, N/A	16, 2.5	8, 3
	1 lb, 2 4Ah	1.3 lbs, 1.8Ah	0.7 lbs, 1.5Ah	0.9 lbs, 2.5Ah	1 lb, 1.3Ah	1 3 lbs, 0 8Ah	1.5 lbs, 2.2Ah	1.3 lbs, 2Ah
	□□	■■	■■	■■	■■	■■	■■	■■
	□□	■■	□■	■□	□□	□□	□■	□□
	■□	■□	■■	□□	□□	□□	■□	■□

CONTINUES

▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Micro Express NP933	Mitsuba Ninja 486SX	PC&C Dynova SLic 3000	Poly NB325T	Poly NBC25	Primax Eagle 425SX
List price (*PC Magazine* configuration)	$1,899.00	$2,149.00	$2,090.00	$1,695.00	$1,770.00	$1,995.00
Processor type and speed	AMD Am386DX/33	Intel 486SX/25	Intel 386SL/25	Intel 386SXLV/25	Intel 386SL/25	Intel 486SX/25
Hard disk capacity	120MB	86MB	130MB	86MB	80MB	80MB
Microsoft Windows 3.1	■	■	□	□	■	□
Dealers/direct-distribution channel	□■	■□	■■	■■	■■	■■
Dimensions (HWD, in inches)	1.8 x 12 x 9.5	2 x 11 x 8.8	2.2 x 11.4 x 8.5	2 x 11 x 8.5	1.5 x 11.3 x 8.5	1.8 x 11 x 8.6
Weight/travel weight (pounds)	7.6, 8.9	6.8, 7.8	7, 8.4	6.8, 8.6	5.1, 6.9	6.4, 8.1
Display area (H x W, in inches)	6.5 x 7.8	5.8 x 7.5	5.3 x 7.2	5.5 x 7.3	5.8 x 7.8	5.8 x 7.6
Keys: total, function, cursor	83, 10, 8	80, 12, 4	82, 12, 4	80, 12, 8	86, 10, 8	82, 12, 4
Motherboard						
Motherboard manufacturer	Micro Express	Quanta	PC&C Research	Compal	Chaplet	Quanta
Chip set manufacturer	ACC	ACC	Intel	Topcat	Intel	ACC
BIOS version (or date)	AMI (7/7/91)	Award (7/8/92)	Quadtel/System Soft (7/5/92)	Phoenix (4/19/90)	Quadtel (6/22/92)	Award (8/19/92)
Setup in ROM/Password in ROM	■■	■■	■■	■■	■□	■■
System shadowing/Video shadowing	□■	■■	□■	■□	■■	■■
Memory and Disk Drives						
Installable RAM	4MB–8MB	4MB–20MB	2MB–32MB	2MB–16MB	2MB–8MB	4MB–20MB
User-installable	□	□	□	■	■	■
External processor RAM cache	None	None	64K	None	16K	None
Available hard disk sizes	80MB, 120MB	80MB, 120MB	85MB, 130MB, 220MB, 230MB	40MB, 130MB, 200MB	40MB, 130MB, 200MB	120MB
I/O and Expansion						
Parallel, serial, mouse ports	1, 1, 0	1, 1, 1	1, 1, 1	1, 2, 0	1, 1, 0	1, 1, 1
Proprietary expansion port	■	□	□	■	□	■
PCMCIA slot	□	□	□	□	□	□
Expansion unit	□	□	□	$380	□	□
Internal modem options	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send-only fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax, 2,400-bps data	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
Video						
Screen manufacturer	Sanyo	Sharp	Hitachi	Sharp	Sharp	Sharp
Maximum shades of gray	64	32	64	16	64	64
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus
Simultaneous external display	□	■	□	□	■	■
Maximum external resolution	800 x 600	800 x 600	800 x 600	640 x 480	800 x 600	800 x 600
Maximum external colors	256	16	16	256	16	16
AC Adapter and Battery						
AC adapter size (inches)	1.5 x 6 x 2.5	1.5 x 4.5 x 3	1.8 x 2.6 x 6	2 x 3 x 6.5	1.8 x 2.5 x 6	1.7 x 7 x 3.2
Rated battery life (hours)	5	2	3.5	5	3	3.5
ZDigit, battery rundowns (hr:min)	3:57, 2:42	3:44, 1:47	3:45, 2:25	3:29, 2:42	3:10, 2:35	3:29, 2:44
Charge time while on, off (hours)	8, 3	16, 2.5	2.1, 2.1	N/A, 3	4, 2	3.5, 2
Battery weight, amp/hour rating	1.9 lbs, 1Ah	1.1 lbs, 1.2Ah	1.4 lbs, 1Ah	0.7 lbs, 0.5Ah	0.7 lbs, 0.5Ah	1.4 lbs, 0.8Ah
Display/hard disk power-down	■■	■■	■■	■■	□■	■■
CPU/peripherals power-down	■■	■■	■■	□■	□□	□■
Standby/Hibernation	■■	■■	■■	□□	□□	■□

N/A—Not applicable. The product does not have this feature.
ACC—ACC Microelectronics, C&T—Chips & Technologies Inc., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

	Primax NightHawk 325SXL	QSI Klonimus Lite 386SL/25	Samsung NoteMaster 386L/25	Tandy 3800 HD	TI TravelMate 4000 WinDX/25	TI TravelMate 4000 WinSX/25	Toshiba Satellite T1800	Toshiba T3300SL
	$1,584.00	$2,289.00	$2,399.00	$2,558.85	$3,299.00	$2,799.00	$1,999.00	$2,798.00
	AMD Am386SXL/25	AMD Am386SXL/25	Intel 386SL/25	Cyrix CX486SLC/20	Intel 486DX/25	Intel 486SX/25	Intel 386SX/20	Intel 386SL/25
	60MB	123MB	64MB	60MB	121MB	121MB	60MB	120MB
	☐	■	☐	■	■	■	☐	☐
	■■	■■	■☐	■☐	■☐	■☐	■☐	■☐
	2.5 x 11.5 x 8.5	1.7 x 12 x 9.5	1.8 x 11 x 8.5	1.6 x 12 x 10	2.2 x 11 x 8.5	1.8 x 11 x 8.5	2 x 11.5 x 8	1.8 x 11.5 x 8.5
	6.5, 7.8	7.5, 9.1	5.8, 7.1	6.2, 6.8	5 5, 6 7	5.5, 6 8	7, 8	5.9, 7.2
	5.8 x 7.5	5.8 x 7.5	5 8 x 7.5	4.8 x 7.5	6 x 8	6 x 8	5 8 x 7.5	5.8 x 7.8
	85, 12, 8	84, 12, 8	80, 10, 4	84, 12, 8	79, 10, 4	79, 10, 4	82, 12, 8	82, 12, 8
	Acer	Modern Computer	Samsung	Tandy	TI	TI	Toshiba	Toshiba
	Acer	C&T	Intel	TI	Intel/TI	Intel/TI	Toshiba	Toshiba
	Acer (10/10/92)	AMI (6/13/90)	Phoenix (1/1/91)	Phoenix (7/13/92)	Phoenix (8/10/92)	Phoenix (5/21/92)	Toshiba (7/17/92)	Toshiba (2/17/92)
	■■	■☐	■☐	☐☐	■☐	■☐	■■	■■
	■■	☐■	■■	■☐	■☐	■☐	■☐	☐■
	2MB–8MB	1MB–8MB	2MB–8MB	2MB–4MB	4MB–20MB	4MB–20MB	2MB–10MB	2MB–6MB
	■	■	■	■	■	■	■	■
	None	None	64K	64K	8K	8K	None	64K
	80MB, 120MB	40MB, 60MB, 80MB, 120MB	40MB, 60MB, 80MB	60MB	120MB, 200MB	120MB	60MB	80MB, 120MB
	1, 1, 1	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
	☐	■	☐	☐	■	■	■	■
	☐	☐	☐	☐	☐	☐	☐	■
	☐	☐	☐	☐	☐	☐	☐	$849
	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps send/receive fax, 2,400-bps/ 9,600-bps send-only fax	2,400-bps/ 9,600-bps MNP 5 send-only fax	2,400-bps/ 9,600-bps MNP 5 send-only fax, 2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps MNP 5 send-only fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
	Sharp	Sanyo	Sharp	Sharp	Sharp	Sharp	Toshiba	Toshiba
	32	64	256	32	64	64	64	32
	Cirrus	Headland	WD	Cirrus	Cirrus	Cirrus	Toshiba	WD
	■	☐	■	☐	■	■	☐	☐
	640 x 480	640 x 480	640 x 480	N/A	1,024 x 768	1,024 x 768	640 x 480	640 x 480
	16	16	256	N/A	256	256	16	256
	1 5 x 6 x 2 5	1.7 x 3.2 x 7	2 x 4 8 x 3 3	3 8 x 2.3 x 1.4	1 5 x 6 x 2.2	1.5 x 6 x 2 2	1 x 5 5 x 3	1 x 5.5 x 3
	2.5	6	2	2	4	4	3.5	3
	2.20, 1:33	4:25, 3:45	N/A, 1:29	2:48, 2:26	4:25, 3:28	3.59, 3:46	4:13, 3.18	5:08, 3:19
	3, 1.8	8, 8	4, 4	8, 4	12, 4	12, 3.5	2, 2	2, 2
	1.1 lbs, 3.9Ah	0.9 lbs, 2.5Ah	0.7 lbs, 1.6Ah	0 5 lbs, 1.3Ah	1 3 lbs, 4.5Ah	1.3 lbs, 4.5Ah	1 6 lbs, 1.4Ah	1.5 lbs, 1.1Ah
	■■	■■	■■	■■	■■	■■	■■	■■
	■■	■☐	■☐	■■	☐■	■☐	☐■	■■
	■☐	☐☐	■☐	■☐	☐☐	☐■	■☐	■■

CONTINUES

▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Twinhead Slimnote 486DX/33	Wyse DecisionMate 486SLC	Z-Note 320L	Z-Note 320Lb	Z-Note 325L	Z-Sport 325S
List price (*PC Magazine* configuration)	$2,875.00	$2,699.00	$2,768.00	$2,368.00	$3,618.00	$2,428.00
Processor type and speed	Intel 486DX/33	Cyrix CX486SLC/25	Intel 386SL/20	Intel 386SL/20	Intel 386SL/25	Intel 386SX/25
Hard disk capacity	130MB	127MB	64MB	64MB	121MB	85MB
Microsoft Windows 3.1	■	■	■	■	■	□
Dealers/direct-distribution channel	■■	■□	■■	■■	■■	■■
Dimensions (HWD, in inches)	1.6 x 11 x 8.5	1.8 x 11 x 8.9	2.2 x 11.8 x 8.5	2.2 x 11.8 x 8.5	2.2 x 11.8 x 8.5	2 x 11 x 8.5
Weight/travel weight (pounds)	6.1, 7.8	4.9, 7.5	5.9, 7.7	5.7, 7.7	5.9, 7.5	6.1, 7.5
Display area (H x W, in inches)	5.8 x 7.7	5.2 x 6.8	5.6 x 7.6	5.8 x 7.6	5.8 x 7.7	5.8 x 7.7
Keys: total, function, cursor	84, 10, 8	79, 10, 4	82, 12, 8	82, 12, 8	82, 12, 8	86, 12, 8
Motherboard						
Motherboard manufacturer	Twinhead	Wyse	ZDS	ZDS	ZDS	ZDS
Chip set manufacturer	ACC	Headland	Intel	Intel	Intel	WD
BIOS version (or date)	Phoenix (6/10/92)	Award (10/2/91)	ZDS (4/22/92)	ZDS (4/22/92)	ZDS (4/22/92)	Phoenix (8/19/92)
Setup in ROM/Password in ROM	■■	■■	■■	■■	■■	■■
System shadowing/Video shadowing	■■	■■	■■	□■	■■	■■
Memory and Disk Drives						
Installable RAM	4MB–16MB	1MB–8MB	2MB–12MB	.2MB–12MB	2MB–12MB	2MB–8MB
User-installable	■	■	■	■	■	■
External processor RAM cache	None	None	None	None	64K	None
Available hard disk sizes	80MB, 130MB	84MB, 120MB, 200MB	60MB, 85MB, 120MB	60MB, 85MB, 120MB	60MB, 85MB, 120MB	60MB, 80MB
I/O and Expansion						
Parallel, serial, mouse ports	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
Proprietary expansion port	■	□	■	■	■	■
PCMCIA slot	□	□	□	□	□	□
Expansion unit	$300	□	$109	$109	$109	$669
Internal modem options	2,400-bps/ 9,600-bps send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
Video						
Screen manufacturer	Sharp	Sharp	Sanyo	Sanyo	Sanyo	Matsushita
Maximum shades of gray	64	32	64	64	64	64
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus
Simultaneous external display	■	□	■	■	■	■
Maximum external resolution	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600
Maximum external colors	16	16	16	16	16	16
AC Adapter and Battery						
AC adapter size (inches)	1.9 x 6.5 x 3.1	1.8 x 5.9 x 3	2 x 6.8 x 3.4	0.7 x 5.5 x 3.6	1.9 x 6.8 x 3.4	2.1 x 7.1 x 3
Rated battery life (hours)	2.5	3	4	2.5	4	2.5
ZDigit, battery rundowns (hr:min)	2:33, 2:04	2:20, 1:29	6.03, 4:27	3.57, 1:58	5:36, 4:21	2:47, 2:03
Charge time while on, off (hours)	4, 2	4, 3	3, 3	N/A, 3	N/A, 3	3.5, 1.5
Battery weight, amp/hour rating	1.3 lbs, 1Ah	0.9 lbs, 18.2Ah	1.2 lbs, 1.3Ah	1.2 lbs, 1.3Ah	1.2 lbs, 1.3Ah	1 lbs, 2.2Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	□□	■■	■■	■■	■■
Standby/Hibernation	■□	□□	■■	■■	■■	■■

N/A—Not applicable The product does not have this feature
ACC—ACC Micro Electronics, C&T—Chips & Technologies Inc , TI—Texas Instruments Inc , VLSI—VLSI Technology Inc , WD—Western Digital Corp

ENDS

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- AMD 386DXL processor rated at 40MHz
- 80MB hard drive • 4MB RAM expandable to 32MB
- 14" Non-interlaced 72Hz HRVGA
- local bus video

Upgradable to 433DLC, 425SX, 440DLC, 433DX, 450DX2, 466DX2

340DX also available in full profile chassis.

Express Low Profile Scalable Systems – Ranked By Speed

System	340DX	433DLC	425SX
Processor	AMD 386DXL	Cyrix 486DLC	Intel 486SX
Norton SI Rating	42	53	53
Price	$1,495	$1,595	$1,695

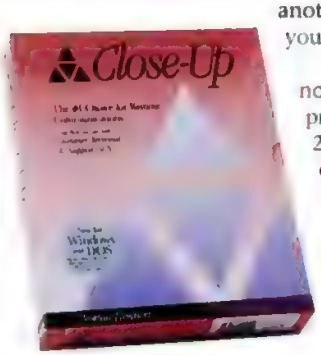
Base System: with 80MB hard drive and 14" NI-HRVGA monito

The Latest In Technical Support

CompuAdd Express has just introduced the best thing ever to happen to technical support — our Remote Rescue program. Using Close-Up 4.0 remote communication software, our support technicians now can use a modem to talk with your PC and solve problems online.

They'll actually be able to diagnose hardware and setup problems and properly configure your system for you — instead of relaying instructions for you to do it yourself!

Remote Rescue uses Close-Up 4.0, the award winning software program that lets an operator at one system use a modem to view and control another computer. *PC Magazine* called it "The best program you can buy for remote control."



Every new CompuAdd Express system, including notebooks, comes with Close-Up 4.0's Customer/Terminal program installed on the hard drive. All you need is a 2400 baud (or higher) modem. Our notebook computers come with a built-in modem.

CompuAdd Express technicians already solve 90 percent of customers' problems in 5 to 10 minutes. This new program makes our technical support faster and more effective than ever.

So just call when you need help. We'll call back online and take it from there. From here!

440 450 466

- Express Scalable systems contain two processor sockets (for different size chips) and a coprocessor socket on the motherboard.
- To upgrade, just pop out the old chip and pop in the new one — you choose between Intel, AMD and Cyrix — and reset the jumpers.
- On board local bus video and 128KB cache speed your work.
- Other built-in functions include IDE controller, floppy drive controllers, one parallel port, two serial ports and keyboard connections.
- Choose an 80MB, 120MB, 170MB or 200MB hard drive.
- Non-interlaced monitors provide true, 72Hz flicker free display
- Three full size and two half size slots on riser card have room for add-ons.
- 4MB standard RAM is expandable to 32MB.
- Low profile chassis has one 5.25" and two 3.5" drive bays.
- Dual floppy drive leaves room for another hard drive or a tape backup.
- MS DOS 5.0, Windows 3.1 and a serial mouse are included free.
- Full profile Scalables have 256KB cache; six I/O slots; three 5.25" and one 3.5" accessible and two 3.5" internal drive bays; interface for a removable hard drive.

440DLC	433DX	450DX2	466DX2
Cyrix 486DLC	Intel 486DX	Intel 486DX2	Intel 486DX2
64	72	95	132
$1,695	$1,795	$1,995	$2,145

- Intel 486DX2 processor rated at 66MHz
- 80MB hard drive • 4MB RAM expandable to 32MB
- 14" Non-interlaced 72Hz HRVGA • local bus video

With 200MB hard drive $2,395

466DX2 also available in full profile chassis.

Our Own Higher Standards

You can count on the people at CompuAdd Express to deliver a top quality computer. And you can count on us for the support and security you want to go with your new system.

- **30-Day Money Back Guarantee.** If you decide during the first 30 days you don't want your system, you can return it for a refund.
- **Toll Free Technical Support.** We provide lifetime free telephone assistance — including our new Remote Rescue program, tech support via fax and our technical bulletin board.
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Our Scalable Systems Change With Your Needs.

Express Scalable 466DX2

- i486DX2 processor rated at 66MHz
- 4MB RAM expandable to 32MB
- 200MB hard drive
- 14" non-interlaced 72Hz HRVGA (1MB memory)
- Local bus video
- Dual floppy drive
- FREE MS DOS 5.0, Windows 3.1, serial mouse

$2,395
Lease for only $88/mo.
Full profile also available

Express Scalable 433DLC

- Cyrix CX486DLC processor rated at 33MHz
- 4MB RAM expandable to 32MB
- 120MB hard drive
- 14" non-interlaced 72Hz HRVGA (1MB memory)
- Local bus video
- Dual floppy drive
- FREE MS DOS 5.0, Windows 3.1, serial mouse

$1,695
Lease for only $62/mo.
Full profile also available

Upgradable to 425SX, 440DLC, 433DX, 450DX2, 466DX2

Express Scalable 340DX

- AMD 386DX processor rated at 40MHz
- 4MB RAM expandable to 32MB
- 80MB hard drive
- 14" non-interlaced 72Hz HRVGA (1MB memory)
- Local bus video
- Dual floppy drive
- FREE MS DOS 5.0, Windows 3.1, serial mouse

$1,495
Lease for only $55/mo.
Full profile also available

Upgradable to 433DLC, 425SX, 440DLC, 433DX, 450DX2, 466DX2

Express Scalable 450DX2

- i486DX2 processor rated at 50MHz
- 4MB RAM expandable to 32MB
- 170MB hard drive
- 14" non-interlaced 72Hz HRVGA (1MB memory)
- Local bus video
- Dual floppy drive
- FREE MS DOS 5.0, Windows 3.1, serial mouse

$2,145
Lease for only $79/mo.
Full profile also available

Upgradable to 466DX2

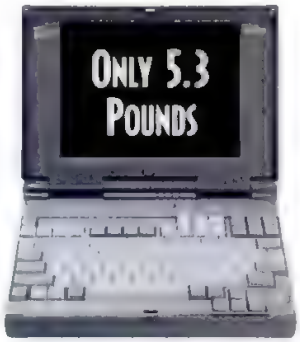
Express 425CX Low Profile

- Cyrix CX486SLC processor rated at 25MHz
- 4MB RAM expandable to 16MB
- 40MB hard drive
- 14" mono VGA monitor (1MB memory)
- Dual floppy drive
- Video accelerator built in on motherboard
- FREE MS DOS 5.0, Windows 3.1, serial mouse

$1,095
Lease for only $40/mo.

Express 425CXL Notebook

- Cyrix CX486SLC microprocessor rated at 25MHz
- Math coprocessor built-in
- Over 2 hours of battery life (depending on application, individual use and power management)
- Super-twist backlit liquid crystal display: 9.4" usable
- 64 levels of grayscale
- 9600 baud fax / 2400 baud modem
- Internal IDE hard drive
- 1.44MB 3.5" internal floppy drive
- 4MB RAM
- Built-in mouse trackball
- FREE MS DOS 5.0, Windows 3.1, LotusWorks 3.0, Quick Link II and carrying case



Express 325NXL Notebook

- AMD 386SX microprocessor rated at 25MHz
- 80387 coprocessor socket
- 3 to 4 hours of battery life
- Super-twist backlit liquid crystal display: 9.4" usable
- 64 levels of grayscale
- 9600 baud fax / 2400 baud modem
- Internal IDE hard drive
- 1.44MB 3.5" internal floppy drive
- 4MB RAM
- Built-in mouse trackball
- FREE MS DOS 5.0, Windows 3.1, LotusWorks 3.0, Quick Link II and carrying case

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FACT FILE

AVI ANB3-386SXL-25
AVI Systems Inc. 1830 Embarcadero, Oakland, CA 94606; 510-535-1020; fax, 510-535-0905

List price (tested configuration): $2,599
Tested configuration: 4MB RAM, 180MB Areal A180 1DE hard disk, DOS 5.0, 1.44MB floppy disk drive.
Options: 2MB RAM upgrade, $180; 6MB RAM upgrade, $540; 9,600-bps send-only/2,400-bps receive-only MNP 5 fax modem, $229; extra battery, $89; extra AC adapter with power cord, $89; car battery adapter, $125.
In short: This product's high price tag is balanced by its solid build, its roster of features, and its benchmark test performance.
581 ON READER SERVICE CARD

over 3 hours with power conservation. Power-management features include adjustable display and hard disk power-downs and a two-stage CPU power-down.

The slightly sticky 84-key keyboard has two embedded function keys (F11 and F12). Highlights are an inverted-T cursor-key arrangement; separate PgUp, PgDn, Home, and End keys; and an embedded numeric keypad.

AVI offers a one-year parts-and-labor warranty, technical support available weekdays and usually on Saturdays, customizable service plans, and on-site service handled through the dealer.—*CK*

Blackship Computer Systems Inc.

BLK 386SL/25NBF

Like some notebooks, the BLK 386SL/25NBF sacrifices battery life for a compact form and a light weight.

The Blackship measures 1.5 by 11.25 by 8.5 inches, and with the battery and

The BLK 386SL/25NBF

SUITABILITY TO TASK
BLK 386SL/25NBF

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

AC adapter, the unit's travel weight is a mere 6.9 pounds. This 386SL/25 sells for $1,795 with 4MB of RAM, an 80MB hard disk, an internal 2,400/9,600-bps send/receive fax modem.

The system's slightly above-average processor performance was offset by its disappointingly low DOS video and Graphics Winmark scores; its memory and disk scores were average. The 0.7-pound nickel cadmium battery lasted 1 hour 15 minutes on our Battery Rundown test without power conservation; with conservation, it lasted 2 hours and 32 minutes on our ZDigit Rundown test.

Power-conservation features, including doze, sleep, and suspend modes, are easy to set from the keyboard. There is a hard disk power-down but no separate LCD power-down. A modem-ring resume feature wakes the suspended system for an incoming call.

The Sharp passive-matrix VGA screen—a 9.5-inch-diagonal backlit CCFT (cold-cathode fluorescent tube) that shows 64 shades of gray—is pleasant to view; this PC can also run an external monitor at Super VGA with 16 colors, although not simultaneously. The 86-key

FACT FILE

BLK 386SL/25NBF
Blackship Computer Systems Inc., 2031 O'Toole Ave., San Jose, CA 95131; 800-531-7447, 408-432-7500

List price (test configuration): $1,795
Tested configuration: 4MB RAM, 80MB Conner CP2088 hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, 2,400/9,600-bps data/fax modem, AC power adapter.
Options: 4MB RAM upgrade, $149; 120MB hard disk, $100; external floppy disk drive, $249.
In short: In keeping the weight of its computer low, Blackship compromises too much on performance.
524 ON READER SERVICE CARD

keyboard has 8 cursor keys, 12 half-height function keys, an Fn key for the numeric keypad, and a built-in trackball.

Blackship Computer Systems includes a one-year parts-and-labor warranty; customers pay one-way shipping to the manufacturer.—*BB*

Chaplet Systems USA Inc.

Chaplet 386 SL25 Notebook

The Chaplet 386 SL25 Notebook is an attractive unit that sells for $2,295 with 4MB of RAM and a 120MB hard disk. Its light weight (6.9 pounds with the AC adapter and battery) and compact dimensions make the Chaplet a good traveling companion, as do the built-in trackball and space for an internal $139 modem,

The Chaplet 386 SL25 Notebook

SUITABILITY TO TASK
Chaplet 386 SL25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

which mean you don't have to carry space-consuming extras.

The Chaplet's performance on our benchmark tests was average in terms of its processor, memory, and disk scores, although its DOS video and Graphics Winmark scores were very low. Because of the lightweight, 0.7-pound nickel cadmium battery, the Chaplet lasted a meager 1 hour 23 minutes without power-conservation features on our Battery Rundown test. Extra batteries cost only $59 apiece and will extend your work time when away from an AC outlet.

The pleasant-to-view Sharp screen is backlit, measures 9.5 inches diagonally,

FACT FILE

Chaplet 386 SL25 Notebook
Chaplet Systems USA Inc. 252 North Wolfe Rd., Sunnyvale, CA 94086; 408-732-7950

List price (test configuration): $2,295.
Tested configuration: 4MB RAM, 120MB Conner CP2124 hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, nylon carrying case.
Options: 2MB RAM upgrade, $195; 4MB RAM upgrade, $345; math coprocessor, $195; 2,400-bps data/9,600-bps send/receive fax modem, $139.
In short: The Chaplet 386 SL25 Notebook is a small and light unit but its battery is comparatively short-lived
525 ON READER SERVICE CARD

uses a CCFT (cold-cathode fluorescent tube), and supports 64 shades of gray. The Chaplet can also run an external VGA or Super VGA monitor with 256 colors, but not simultaneously. The 86-key keyboard's 10 half-height function keys (2 of which double as F11 and F12) and 8 cursor and page-movement keys had a good feel.

Chaplet Systems USA's service and support is paltry compared with that of its competitors. It offers a one-year parts-and-labor warranty and mirror-shipping but provides no on-site service, money-back guarantee. The lifetime technical support, available weekdays from 8:00 to 6:00 Pacific time, is via a toll line.—*BB*

Compaq Computer Corp.

Compaq Contura 3/20
Compaq Contura 3/25

If there is a trend in laptops today, it's toward lower-price machines with less frills. Compaq breaks from that mold, with a line of full-featured, price-competitive notebooks: the $1,892 Compaq Contura 3/20 and the $2,074 Compaq Contura 3/25.

Each Contura weighs 6.2 pounds with a battery and has a charcoal-color case with rounded edges and an easy-grab ledge for secure carrying. Inside, the famous purple switches handle the power and standby modes. The battery is easy to remove, but you will have to take out the keyboard to get to the memory, math coprocessor, and modem.

A full complement of I/O ports (including one for an external VGA monitor and a mini-DIN plug that doubles as an external keyboard or PS/2 mouse connector) are tucked away behind a small plastic door.

The Compaq Contura 3/25 and the Compaq Contura 3/20

The 386SX/20 Contura 3/20 can accommodate between 2MB and 10MB of RAM (we tested it with 4MB) and comes with an 84MB hard disk; the Contura 3/25 we tested held a 386SX/25 processor, 4MB of RAM (expandable to 12MB), a 60MB hard disk (40MB, 80MB, and 120MB sizes are available), and a 64K four-way set-associative external cache. You also get an internal 3.5-inch floppy disk drive and even a Logitech TrackMan Portable that has been painted gray and carries the Compaq label. Compaq's 79-key keyboard has standard-spaced keys, including separate Home, End, PgUp, and PgDn keys and an inverted-T cursor-key layout. Though the key travel is inadequate, the resistance isn't too tight. A 9.5-inch-diagonal screen is bright enough to display Windows adequately. You can customize display and power-management features on the fly.

The documentation is complete, but not the most straightforward we've seen. Some Contura 3/25s come bundled with Windows 3.1 and PFS:WindowWorks.

SUITABILITY TO TASK

Compaq Contura 3/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Compaq Contura 3/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Check with dealers for current prices.

On our benchmark tests, the Contura 3/25 was an adequate performer, while the Contura 3/20's scores were the lowest in more than one category. Neither processor is one of the new low-voltage, 3.3-volt chips—probably a cost consideration on the company's part—but their battery lives were still fairly competitive: The Contura 3/20 and Contura 3/25 lasted 2 hours 28 minutes and 2 hours 15 minutes, respectively, on our Battery Rundown test (without power conservation); on our ZDigit Rundown test (with power conservation), they lasted 4 hours 53 minutes and 4 hours 11 minutes, respectively.

Compaq's one-year parts-and-labor warranty includes on-site service and service via its authorized service centers. Tech support is toll-free.—*OR*

FACT FILE

Compaq Contura 3/20, 3/25
Compaq Computer Corp., P.O. Box 692000, Houston, TX 77069-2000; 800-370-0670

List price (tested configuration): 3/20—$1,892.
Tested configuration: 4MB DRAM, Compaq 84MB IDE hard disk , DOS 5.0, PFS:WindowWorks, 1.44MB floppy disk drive, Compaq passive TFT edge-lit LCD screen; 2,400/9,600-bps data/fax modem.
List price (tested configuration): 3/25—$2,074.
Tested configuration: Compaq 60MB IDE hard disk, other components as above.
Options: 3/20 and 3/25—2MB RAM upgrade, $131; 4MB RAM upgrade, $279; 8MB, $559; 2,400-bps modem, $262; 9,600-bps modem, $526; 2,400/9,600-bps data/fax modem, $262.
In short: These competitive and practical low-cost portables should be considered seriously by buyers with limited budgets.
527 ON READER SERVICE CARD

Compaq Computer Corp.

Compaq LTE Lite/25E

The most extraordinary aspect of the Compaq LTE Lite/25E is its active-matrix monochrome display—the first notebook to have one. Add to that a high-speed data/fax and cellular modem touted as the first internal, MNP 10 error-control modem for portables and you have a sure winner.

The Compaq LTE Lite/25E

This 386SL/25 measures 2 by 11 by 8.5 inches and weighs just under 6.5 pounds. It came with 4MB of RAM (expandable to 20MB), a 64K cache, and an 80MB hard disk. But the center of attention is its 9.5-inch-diagonal active-matrix display, capable of 16 shades of gray at VGA and 64 at 320-by-200. The screen is readable at any angle, and the Compaq video chip set can simultaneously run a VGA monitor with 256 colors.

Within this CPU class, the Lite/25E's performance was impressive, particularly its DOS video score, which was third-highest. On our Battery Rundown test without power conservation, it lasted a respectable 2 hours 38 minutes. Its ZDigit Rundown score of 4 hours 11 minutes with power conservation is impressive.

Compaq's only stumble with this notebook is the trackball, which is by no means the worst we've seen. The ball is too small for most fingers and offers no resistance. Compaq offers a port replicator similar to Zenith Data Systems' ReadyDesk; the Lite/25E does have a PCMCIA II slot. There is also an optional 14,400-bps data/9,600-bps send-fax modem.

The Compaq Lite/25E comes with a one-year parts-and-labor warranty and on-site service. Toll-free support is available weekdays.—*Brad Grimes*

SUITABILITY TO TASK

Compaq LTE Lite/25E

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

FACT FILE

Compaq LTE Lite/25E

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77069-2000; 800-345-1518, 713-370-0670

List price (tested configuration): $2,999.
Tested configuration: 4MB RAM, Compaq 80MB hard disk, DOS 5.0, Windows 3.1, Compaq UltraView Display, 1.44MB disk drive.
Options: 2MB RAM upgrade, $264; 16MB, $2,211; docking station, $699; 2,400/9,600-bps data/fax modem, $262; 9,600-bps modem, $526; Compaq SpeedPAQ 14,400/9,600-bps data/fax modem, price N/A.
In short: A winner with a great active-matrix display.
526 ON READER SERVICE CARD

CompuAdd Express

CompuAdd Express 425CXL-80

The CompuAdd Express 425CXL-80 is a 2- by 11- by 8.5-inch notebook with a difference: an uncramped keyboard and a built-in trackball. Its $2,245 price includes a Cyrix Cx486SLC/25 CPU, 4MB of RAM, an 80MB hard disk, and a mono LCD panel.

The CompuAdd Express 425CXL-80

With a battery and AC adapter, The CompuAdd's travel weight is just under 7 pounds. The large transformer on the AC adapter plugs directly into a wall outlet but may obstruct other outlets.

The CompuAdd costs about the same as competing machines based on the Intel 386SL/25 but outperformed them at nearly every turn. Its Battery Rundown time (without power conservation) of 2 hours 9 minutes was average; with power management enabled for our ZDigit Rundown test, it lasted 39 more minutes.

The Esc and function keys are about three-fourths the size of standard keys, as are the Ins, Del, Home, End, PgUp, and PgDn keys. The cursor keys are also three-quarter–size and in an inverted-T layout. You'll need both hands to work the trackball, which uses the M1 and M2 keys as its buttons; it is relatively easy to control—if you are right-handed.

The Sharp TSTN (triple-supertwist nematic) backlit VGA screen is crisp and clear. Four tiny keyboard buttons control the brightness and contrast. CompuAdd backs this portable with a one-year parts-and-labor warranty, with a overnight exchange for the defective unit in the first 30 days. The company will also bundle Close-Up, which will let technicians use a modem to perform remote diagnostics.—*Alfred Poor*

SUITABILITY TO TASK

CompuAdd Express 425CXL-80

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

CompuAdd Express 425CXL-80

CompuAdd Express, 12301 Technology Blvd., Austin, TX 78726; 800-925-7811

List price (tested configuration): $2,245.
Tested configuration: 4MB RAM, 80MB Western Digital WD AH280-00 hard disk, DOS 5.0, Microsoft Windows 3.1, Lotus Works 3.0, 1.44MB floppy disk drive, 2,400/9,600-bps fax modem.
Options: 8MB RAM upgrade, $275; external keyboard, $49.50; extra battery, $29.95, battery charger, $89.
In short: The CompuAdd Express 425CXL-80 combines a full-size keyboard with impressive performance.
528 ON READER SERVICE CARD

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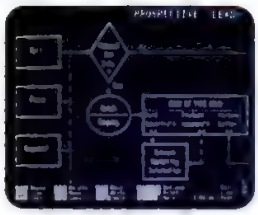

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Dell Computer Corp.

Dell Dimension NL20

The $1,748 Dell Dimension NL20's excellent battery life, below-average performance, and mediocre portability provide a laptop for the budget-conscious user looking for a solidly built machine.

The 1.8- by 11- by 8.3-inch 386SL/20 came with 4MB of RAM (user-expandable to 8MB), a 60MB Conner IDE hard disk with a 32K buffer (the maximum), DOS 5.0, Microsoft Windows 3.1, and a Microsoft BallPoint Mouse. Its performance and 7.6-pound travel weight are not impressive, but the Dimension does have a good battery life, price, and service and support policy.

Although its memory, disk, and processor scores were among the lowest in the monochrome category, this portable's Disk Winmark score was the highest of the four 386SL/20 reviewed laptops. Its Graphics Winmark score was below the average for its processor group.

Without power conservation, the 1.5-pound nickel cadmium battery lasted 3

SUITABILITY TO TASK

Dell Dimension NL20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Dell Dimension NL20
Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355

List price (tested configuration): $1,748.
Tested configuration: 4MB RAM, 60MB Conner CP2064 IDE hard disk, DOS 5.0, Microsoft Windows 3.1, Microsoft BallPoint Mouse.
Options: 2MB RAM upgrade, $149; math coprocessor, $149-$159; 2,400-bps send-only fax modem, $99; 2,400-bps send/receive fax modem, $149.
In short: The NL20 falls short in portability and performance, but scores points for its price and battery life, and the manufacturer's service and support.

531 ON READER SERVICE CARD

The Dell Dimension NL20

hours 12 minutes, and with power conservation it lasted 3 hours 30 minutes. Power conservation included an Auto Suspend and adjustable power-down features for all components except the CPU.

Sharp's TSTN edgelit VGA screen displayed text and images crisply, but at 8.6 inches diagonally it was noticeably smaller than most. The 85-key keyboard includes 12 half-height function keys and has an inverted-T cursor layout, along with separate Home, End, PgUp, and PgDn keys.

Dell offers a one-year parts-and-labor warranty, technical support available seven days a week, a bulletin board through CompuServe, and support and technical fax services.—*Camille N. Cline*

Dell Computer Corp.

Dell System 320SLi

"You don't think about taking it along, you just do," said *PC Magazine* contributing editor M. David Stone. The light, 3.8-pound Dell System 320SLi heralds changing times in the notebook industry.

The 1.3- by 11- by 7.8-inch 320SLi's $2,547 price includes 4MB of RAM, a 60MB Conner IDE hard disk with a 32K buffer, a PCMCIA slot, an external floppy disk drive that is only slightly larger than the 3.5-inch floppy disks it uses, DOS 5.0, Microsoft Windows 3.1, and Lotus Organizer.

The Dell System 320SLi

The 0.7-pound battery and 1.1-pound AC adapter brought the travel weight up to 5.5 pounds. This unit ranked at the top of its four-member processor class and bested one in the next-highest category. The nickel hydride battery lasted 3 hours 8 minutes without power conservation on our Battery Rundown test. Because the LCD is not illuminated, this PC could not run our ZDigit Rundown test. The power-management features includes adjustable display, hard disk power-down, and auto suspend modes.

The PCMCIA Type II slot takes a credit card–size modem. Although the case is small, its reflective TSTN LCD panel is 9.5 inches diagonally. Inverted-T cursor keys; separate Home, End, PgUp, and PgDn keys; and 12 half-height function keys fill the 85-key keyboard. The cursor and function keys can double as a pointing device.

Dell Computer Corp. offers a one-year parts-and-labor warranty. The first-year of on-site service can be expanded up to four more years for an additional cost.—*CNC*

SUITABILITY TO TASK

Dell System 320SLi

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Dell System 320SLi

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355

List price (tested configuration): $2,547.

Tested configuration: 4MB proprietary RAM, 60MB Conner CP2064 IDE hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, PCMCIA modem.

Options: 2MB RAM upgrade, $149; 8MB RAM upgrade, $599, 80MB hard disk, $200; 120MB hard disk, $400; math coprocessor, $149; 2,400-bps PCMCIA data modem, $249.

In short: The 320SLi delivers a lot of capability in a small package

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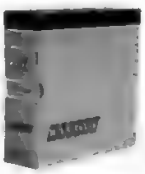

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Dell Computer Corp.

Dell System 325N

A $2,698 Editors' Choice award in our August 1992 issue, the Dell System 325N is an even fiercer contender at $2,249. An exceptional battery life makes it even more terrific.

The System 325N came with a 386SL/25 CPU, 4MB of RAM (expandable to 12MB), a fixed 64K external cache, a 60MB Conner IDE hard disk with a 32K buffer, DOS 5.0, Microsoft Windows 3.1, and a Microsoft BallPoint Mouse.

The Dell System 325N

The System 325N's travel weight is 7.4 pounds and its case measures 2.3 by 11 by 8.5 inches. This portable's performance was average across the board, except for its nickel hydride battery's superb life. Without power conservation, it lasted 3 hours 41 minutes; with power conservation (adjustable display and hard disk power-downs, fixed CPU and peripheral power-downs, and an adjustable Auto Suspend), its excellent time of 5 hours 7 minutes placed it sixth among the 62 monochrome units.

You can install a coprocessor and memory through the top of the system. A sliding back panel reveals the ports and DC power jack. A 9.5-inch-diagonal Sharp screen, which uses edgelit TSTN (triple-supertwist nematic) technology, is crisp, clear, and easily adjustable. The 85-key keyboard includes separate Home, End, PgUp, and PgDn keys, cursor keys in an inverted-T layout, and 12 half-height function keys.

Dell Computer Corp. provides a one-year parts-and-labor warranty with on-site service or replacement. On-site service is expandable to four years.—*CNC*

SUITABILITY TO TASK

Dell System 325N

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	○	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Dell System 325N
Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355

List price (tested configuration): $2,249.
Tested configuration: 4MB proprietary RAM, 60MB Conner CP2064 IDE hard disk, DOS 5.0, Microsoft Windows 3.1.
Options: 2MB RAM upgrade, $149; 8MB, $599; 120MB hard disk, $400; 1.2MB floppy disk drive, $249; math coprocessor, $149-$199; 9,600/2,400-bps fax modem, $149; 9,600/2,400-bps send/receive fax modem, $599.
In short: Lengthy battery life, good test scores, and resonable price make the 325N a solid buy.
530 ON READER SERVICE CARD

Digital Equipment Corp.

DECpc 325P

GRiD Systems Corp.

GRiD 1660

GRiD 1755 486SLC

Like triplets dressed up in different clothes, Digital's DECpc 325P, the GRiD 1660, and the GRiD 1755 486SLC units may all have slightly different-color cases, but otherwise you would be hard pressed to tell them apart. Manufactured in Japan, with a Matsushita motherboard, these three machines include many useful features but have disappointing battery lives.

Though their prices seem steep for notebooks based on the 386SL/25 processor (the DECpc and GRiD 1660) or Cyrix Cx486SLC/25 (the GRiD 1755 486SLC), these machines have durable cases and weigh about 7.1 pounds each. The DECpc and GRiD 1660 had 120MB hard disks, and the GRiD 1755 had a 80MB unit. The DECpc, which came with 8MB of RAM, sells for $3,295; GRiD Systems Corp. charges $3,220 for a GRiD 1660 with only 4MB of RAM, and $3,020 for the GRiD 1755.

They all have 9,600-bps modem options, simultaneous external VGA display with 16 colors, and relatively small

SUITABILITY TO TASK

DECpc 325P

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

SUITABILITY TO TASK

GRiD 1660

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

GRiD 1755 486SLC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

FACT FILE

DECpc 325P
Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 508-493-5111, 800-722-9332

List price (tested configuration): $3,295.
Tested configuration: 8MB DRAM, Conner CP-2084 120MB IDE hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive, Sharp edge-lit LCD screen.
Options: 2MB RAM upgrade, $175; 4MB RAM upgrade, $325; 6MB RAM upgrade, $475; math coprocessor, $229; external keyboard, $75; Xircom Ethernet adapter (thin, thick, or twisted pair), $405; extra battery, $179; extra ac adapter, $99; car battery adapter, $129; leather carrying case, $150; 2-slot expansion chassis, $599; docking station, $799.
In short: The 386SL/25-based DECpc 325P lags behind other units in this review in battery life and performance.
532 ON READER SERVICE CARD

1992 Service and Reliability Survey

8,592 *PC Magazine* subscribers responded to our survey on service and reliability in the PC industry. Here's how they rated 14 of the top laptop and notebook vendors.

The 1992 *PC Magazine* Service and Reliability Survey was published in our May 26, 1992, issue. The following tables summarize the numerical results from the laptop and notebook computer section of our survey.

These *PC Magazine* subscriber ratings of laptop and notebook PC manufacturers are based on 8,592 responses and cover those brands the participants used in the previous two years. We calculated an average score for each manufacturer, based on responses reported on a scale of 1 to 10. For more details, see our May 26 issue.

The 1992 PC Magazine Service and Reliability Survey

LAPTOPS AND NOTEBOOKS (BY MANUFACTURER)

Overall PC reliability		Future likelihood of buying from the same vendor		Satisfaction with repair service		Satisfaction with technical support	
Zeos International Ltd.	9.18	Dell Computer Corp.	8.53	Dell Computer Corp.	8.89	Dell Computer Corp.	9.12
AST Research Inc.	8.91	AST Research Inc.	8.33	Zeos International Ltd.	8.57	Zeos International Ltd.	8.66
Toshiba America Information Systems Inc	8.81	Zeos International Ltd.	8.28	AST Research Inc.	8.26	AST Research Inc.	8.06
Dell Computer Corp.	8.80	Toshiba America Information Systems Inc.	7.65	Compaq Computer Corp.	7.94	Compaq Computer Corp.	7.79
Compaq Computer Corp.	8.74	CompuAdd Computer Corp.	7.44	IBM Corp.	7.83	CompuAdd Computer Corp.	7.67
Tandy Corp./GRiD Systems Corp.	8.67	Compaq Computer Corp.	7.18	Toshiba America Information Systems Inc.	7.65	Toshiba America Information Systems Inc.	7.63
Texas Instruments Inc.	8.63	Texas Instruments	6.75	CompuAdd Computer Corp.	7.50	IBM Corp.	7.61
IBM Corp.	8.57	Sharp Electronics Corp.	6.63	Bondwell Industrial Co.	7.43	Bondwell Industrial Co.	7.41
Bondwell Industrial Co. Inc.	8.51	Bondwell Industrial Co.	6.60	Tandy Corp./GRiD Systems Corp.	7.32	Tandy Corp./GRiD Systems Corp.	7.33
Epson America Inc.	8.46	IBM Corp.	6.11	NEC Technologies	7.27	Epson America	7.06
CompuAdd Computer Corp.	8.45	Tandy Corp./GRiD Systems Corp.	5.98	Sharp Electronics Corp.	7.15	NEC Technologies	7.00
NEC Technologies Inc.	8.28	NEC Technologies	5.81	Texas Instruments	6.93	Texas Instruments	6.72
Sharp Electronics Corp.	8.26	Epson America	5.48	Zenith Data Systems	6.78	Zenith Data Systems	6.70
Zenith Data Systems	7.97	Zenith Data Systems	5.40	Epson America	6.69	Sharp Electronics Corp.	6.53
Average	**8.59**	**Average**	**6.87**	**Average**	**7.59**	**Average**	**7.52**

Scale: 1 (lowest rating) to 10 (highest rating).

AC adapters; all three make good traveling companions. The DECpc and GRiD 1660 also included a built-in trackball that didn't work well, and was not missed on the GRiD 1755.Fortunately, a mouse port resides on the system's right side, next to the keyboard port.

None of these notebooks excelled on PC Magazine Labs' battery tests, though all three of them employ the 386SL CPU's power-management features. On our Battery Rundown test, the GRiD 1660 lasted 2 hours 9 minutes; the DECpc lasted an additional 22 minutes. The GRiD 1755 was the family laggard, with a score of 1 hour 53 minutes. On our ZDigit test with power conservation, the 1660 outlasted the DECpc: 4 hours 11 minutes compared with 3 hours 30 minutes. The 1755 trailed once again, with a score of 2 hours 47 minutes.

On our other tests, the GRiD 1660 and DECpc performed similarly, except that the GRiD's processor marginally outperformed the Digital's. The three systems turned in video scores that exceeded the average by about 20 percent under both DOS and Windows; other scores were average.

The edgelit 8.5-inch Sharp triple-supertwisted VGA LCD panel was fine when it was adjusted for the best possible viewing angle, but it faded when viewed from the periphery. Also, the screen folds only to about a 90 degree angle.

Digital's DECpc 325p, the GRiD 1660, and the GRiD 1755 486SLC

The units' 84-key keyboards are well-sized but also somewhat stiff, with very legible white-on-black lettering. There are 12 function keys and cursor keys in an inverted-T layout, but the units have only one Alt and one Ctrl key.

The GRiDs come with a one-year warranty, on-site service, and toll-free tech support. On-site service costs extra. The DECpc has a one-year parts-and-labor warranty, toll-free tech support, and DEC Passport Service, where repairs are expedited and handled by express courier pick-ups.—*RA and Julie Cohen*

FACT FILE

GRiD 1660

GRiD 1755 486SLC

GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94537; 510-656-4700

List price (tested configuration): $3,220 (GRiD 1660), $3,020 (GRiD 1755 486SLC)

Tested configuration: Conner CP-2084 120MB IDE hard disk, Sharp edge-lit LCD (1660); Conner CP2084 80MB hard disk, Sharp triple-supertwisted LCD (1755 486SLC) 4MB RAM, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive

Options: 2MB RAM upgrade, $225; 6MB RAM upgrade, $595, math coprocessor, $189

In Short: Well-built and solid units, but disappointing performers on PC Magazine Labs' tests

591 ON READER SERVICE CARD

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CIRCLE 044 ON READER SERVICE CARD

DTK Computer Inc.

DTK Grafika 3N

The DTK Grafika 3N is easily upgradable but is an uninspired performer.

The 2- by 11.5- by 8.2-inch Grafika weighs 7.6 pounds with a battery and AC adapter. Our test unit came with a 120MB Seagate IDE hard disk (the $1,922 price includes an 80MB unit), 5MB of RAM, Microsoft Windows 3.1, and DOS 5.0. A small panel above the keyboard lifts out easily, making RAM and BIOS upgrades simple even for a novice. The 8.5-inch-diagonal Epson CCFT backlit LCD is controlled by a Western Digital chip set.

The DTK Grafika 3N

SUITABILITY TO TASK

DTK Grafika 3N

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

On our benchmark tests, the Grafika pulled in weak DOS scores for its processor class; DOS video and Graphics Winmark scores were only slightly above-average. Its Battery Rundown score (just over 2 hours) was moderate; with power conservation, it lasted almost 3 and a half hours.

The 85-key keyboard features inverted-T cursor keys and separate Home, End, PgUp, and PgDn keys. The function keys are half-height but easy to use.

One inconvenience is the placement of the backspace key, next to the Home key, making inadvertent keystrokes a likelihood. The screen is attached by a partial hinge and tilts to only 105 degrees.

DTK offers a 2,400/9,600-bps modem with MNP 5, V.42, and send/receive fax capabilities for only $150. There is a one-year parts-and-labor warranty, and the company pays for return shipping.—*CK*

FACT FILE

DTK Grafika 3N

DTK Computer Inc., 17700 Castleton St., #300, City of Industry, CA 91748; 800-925-7318; 818-810-8880; fax, 818-810-3722

List price (tested configuration): $1,922

Tested configuration: 5MB RAM, 80MB Seagate hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: upgrade to 5MB RAM, $195; 9,600/2,400-bps MNP 5 send/receive fax modem, $150

In short: This unit suffers from poor ergonomics and unimpressive performance. These drawbacks are somewhat balanced by a low price

533 ON READER SERVICE CARD

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CIRCLE 188 ON READER SERVICE CARD

Everex Systems Inc.

Everex Carrier SL/25

At $2,438, the Everex Carrier SL/25 is a pleasantly detailed and full-featured entry with the bundled software and attention to ergonomics that separates it from the rest. The Carrier's 2- by 11- by 8.5-inch case weighs slightly under 6 pounds with the battery and has a decently sized AC adapter. Opening the case was too easy, because during testing one of its

The Everex Carrier SL/25

small latches broke. The 1.44MB floppy disk drive, battery, and hard disk are all front-mounted and the latter two are easily removable (although you can't use the extra space to hold an additional battery). Underneath is a slide-off slot for accessing the math coprocessor.

On the keyboard, the functions keys are the only shortcoming: They're about quarter-height and handle too many operations. Generous key spacing, decent travel and tactile feedback, and separate Home, End, PgUp, and PgDn keys as well as inverted-T cursor-control keys contribute to a productive portable workhorse. The internal trackball is still not as good as a mouse, but it is a workable setup as long as you can use both hands.

Inside, Everex offers an Intel 386SL/25 CPU, an AMI BIOS that's flash-upgradable, between 2MB and 20MB of RAM, and a 64K external cache. The right side holds an optional 2,400-bps MNP 5 modem. The removable IBM-made 81MB IDE hard disk carries an internal 32K buffer. The Cirrus Logic video chip set is capable of 800-by-600 external resolution in 16 colors and supports simultaneous display.

The Carrier managed competitive numbers on all PC Magazine Labs tests without exception. Everex covers this system with a one-year warranty on parts and labor.—*OR*

SUITABILITY TO TASK

Everex Carrier SL/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Everex Carrier SL/25
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 800-821-0806, 510-498-1111; fax, 510-683-2300

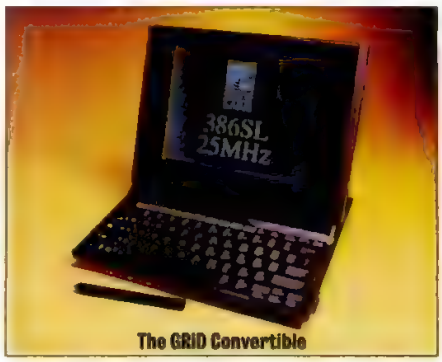
List price (tested configuration): $2,438.
Tested configuration: 4MB RAM, IBM WDA-280 81MB IDE hard disk, Sharp LM64P762 TSTN backlit LCD, 1.44MB floppy disk drive
Options: 6MB RAM upgrade, $349; 18MB, $2,399; extra 80MB hard disk module, $529; math coprocessor, $109; 9,600/2,400 send-only fax modem, $139.
In short: Solid performance matched with an attractive feature set make this product a contender
534 ON READER SERVICE CARD

GRiD Systems Corp.

GRiD Convertible

The $3,400 GRiD Convertible is a hybrid portable and stylus. It promises a lot and delivers in some respects, but it falls flat in others.

At 5.5 pounds, the 1.6- by 11.5- by 9.4-



The GRiD Convertible

inch Convertible seems aimed at those who need to be weaned from their keyboards. It came with 8MB of RAM with a 64K external RAM cache, a Toshiba 120MB hard disk with a 32K cache, and

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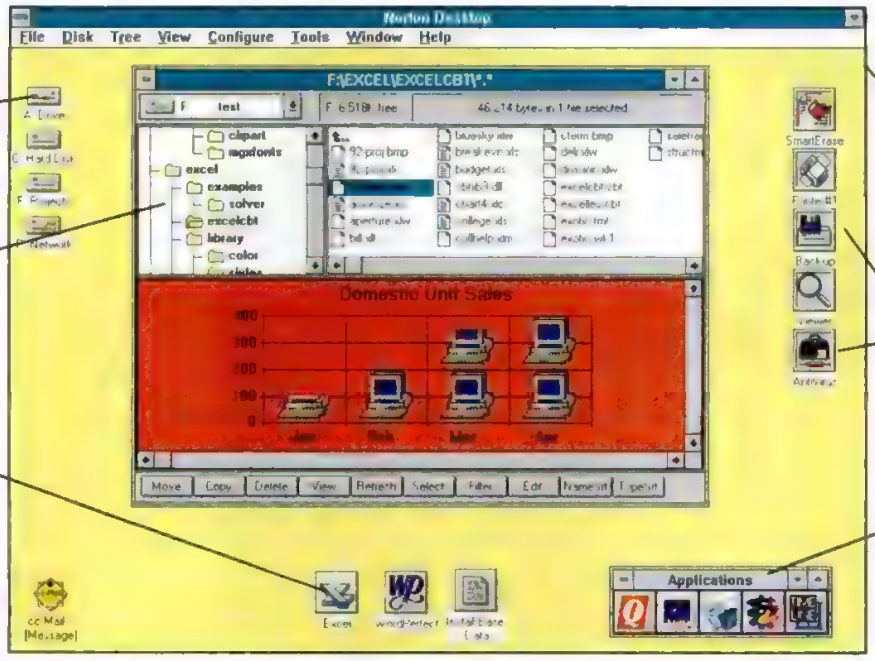
With Norton Desktop for Windows, your drive icons sit right on the desktop, so you get direct access to your files.

Click on a drive icon for easy file management. The drive window includes a tree pane, file pane, and a customizable button bar with a view option.

For total convenience, applications or files can be dragged onto the desktop for easy access. Open files effortlessly with a quick mouse click or, by dragging the file to the application.



The Norton Desktop is a completely integrated environment. You can drag and drop files from the drive window to a tool, drive icon, application, or onto the desktop itself.

All the utilities you need to backup, protect, and repair your data sit right on your desktop. You can drag files or drive icons directly to the tool you need.

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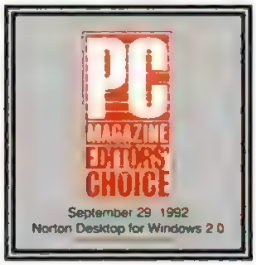
We all know time is money. And because Norton Desktop looks so much like Windows, you won't have to waste time learning how to use it. You get most everything you need to run your PC in one comprehensive package — a great, money-saving value.



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CIRCLE 350 ON READER SERVICE CARD

an external 1.44MB floppy disk drive.

You can use the cordless pen to draw directly on the case. It worked well with the supplied pen-driven utilities.

The Cirrus video chip set with 256K of video memory can simultaneously run

The GRiD convertible is a hybrid portable and stylus that promises a lot and delivers in some respects, but it falls flat in others, such as battery life.

its 9.5-inch-diagonal Sharp VGA LCD panel at 16 colors and an external monitor.

The Convertible's nickel cadmium battery lasted only 1 hour 21 minutes without power conservation and 1 hour 39 minutes with conservation. This notebook's other scores were redeeming: a disk score at the top of its CPU class and above-average scores under Windows.

The company offers a one-year parts-and-labor warranty, and a loaner option is available.—*RA*

SUITABILITY TO TASK

GRiD Convertible

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

GRiD Convertible

Grid Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94537; 800-222-4743

List price (tested configuration): $3,400

Tested configuration: 8MB RAM, Toshiba 120MB hard disk, DOS 5.0, Windows 3.1, Sharp FSTN display, external 1.44MB floppy disk drive

Options: 2MB RAM upgrade, 6MB RAM upgrade, 2,400/9,600-bps fax modem, Slate/GRiD Pen Essentials, including four Slate software programs (prices not available)

In short: An intriguing and versatile blend of pen and laptop technologies

535 ON READER SERVICE CARD

IBM Personal Computer Co.

IBM PS/note N45sl

The IBM PS/note N45sl, IBM's first competitively priced portable, is a PC with a split personality: There's a lot to recommend this $2,045 25-MHz 386SL notebook, but there are some flaws.

The PS/note comes with 2MB of RAM and an 80MB hard drive. It's sturdy, but slightly large at 2 by 12.3 by 8.3 inches. It weighs almost 7 pounds with its battery installed. Power-management features are in erasable-programmable ROM (EPROM) and allow users to power down the display and hard disk, as well as to adjust standby and auto rest. The keyboard is what you've come to expect from Big Blue. It's comfortable and spacious, with 12 full-size function keys and 8 cursor keys.

The screen, however, is a disappointment. The 9.5-inch LCD is difficult to read without constantly manipulating the display controls or tilting the screen. You can attach an external monitor, but there is no simultaneous external display capability. The PS/note can accommodate

The IBM PS/note N45sl

SUITABILITY TO TASK

IBM PS/note N45sl

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

CIRCLE 213 ON READER SERVICE CARD

FACT FILE

IBM PS/note N45sl

IBM Personal Computer Co., Rte. 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329

List price (tested configuration): $2,045.
Tested configuration: 2MB RAM, 80MB Conner CP-2084 hard disk, 1.44MB floppy disk drive.
Options: 2MB RAM upgrade, $265; extra battery, $150; 9,600-bps fax modem, $365; 2,400-bps data modem, $265, PS/2 miniature mouse, $75
In short: The PS/note N45sl is well-designed and performs respectably, but the package loses points for its screen.
536 ON READER SERVICE CARD

8MB of RAM and a 120MB hard disk.

IBM's PS/note earned solid marks on all of PC Magazine Labs' tests. It had a sluggish feel, although its processor scores were above average. IBM rates the battery life of the PS/note at 3 hours. Our test unit lived up to that rating and stretched its life to nearly 3 hours 45 minutes on our ZDigit Rundown test.

The PS/note comes with a one-year warranty. On-site service is available at a negotiable fee. IBM includes HelpWare free of charge, which includes toll-free support.—*BG*

Identity Systems Technology Inc.

Identity 386SXL-25 Notebook Computer

The $2,595 Identity 386SXL-25 Notebook Computer's biggest appeal is its

The Identity 386SXL-25 Notebook Computer

210MB Conner hard disk. If that isn't enough for your future files, the company plans to have a 500MB version available by press time for $2,995. But this AMD-386SXL/25-based unit suffers from spotty performance.

SUITABILITY TO TASK

Identity 386SXL-25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The 2.3- by 11- by 8.6-inch case weighs 6.8 pounds with its battery. Identity Systems Technology stocked our test unit with a 12-ms 210MB Conner IDE hard disk, 4MB of RAM, a 1.44MB floppy disk drive, DOS 5.0, Windows 3.1, and Works for Windows. The 8.5-inch backlit screen is controlled by a Cirrus Logic chip set with 256K of VRAM. While this machine can support an external monitor with 800-by-600 resolution and 16 colors, it doesn't support simultaneous display.

FACT FILE

Identity 386SXL-25 Notebook Computer

Identity Systems Technology Inc., 1347 Exchange Dr., Richardson TX 75081; 214-235-3330; fax, 214-907-9227

List price (tested configuration): $2,595
Tested configuration: 4MB RAM, 210MB Conner hard disk, DOS 5.0, Windows 3.1, Works for Windows, 1.44MB floppy disk drive.
Options: 4MB RAM upgrade, $259, 500MB hard disk, $400; 9,600-/2,400-bps MNP 5 fax modem, $269
In short: Uneven performance and short battery life are drawbacks; plentiful hard disk space is a plus.
537 ON READER SERVICE CARD

On PC Magazine Labs' disk tests, the Identity produced stellar scores. On the DOS video and Windows graphics tests, however, it came in at the bottom of the heap. Results from the Battery Rundown test (1 hour 45 minutes) and the ZDigit Rundown test (2 hours 34 minutes) were also uninspiring. The unit suffered some design drawbacks, such as a single plastic back flap covering all of the input ports, including the power port. The screen tilts only to 115 degrees, the F11 and F12 keys are embedded, and the Fn keys are only half width; on the plus side, the cursor keys are in an inverted T and the PgUp, PgDn, Home, and End keys are separate. The unit has two serial ports, and a Thumbelina thumbmouse is included. The Identity comes with a one-year warranty.—*CK*

Jetta International Inc.

Jetbook 486DX/33

The $2,598 Jetbook 486DX/33, from Jetta International, delivers outstanding performance and offers plenty of options. There's just one problem: The battery keeps falling out. Until the company fixes this, plan to invest in lots of tape.

The 2.3- by 11.5- by 9-inch case weighs 6.6 pounds with its 1.8-pound battery installed, or 8.1 pounds with the AC adapter. The case holds an 80MB 19-ms Toshiba IDE hard disk, 4MB of 70-ns proprietary RAM, and a 1.44MB floppy disk drive. The 9.5-inch-diagonal Hitachi TSTN edgelit screen is controlled by a Cirrus Logic chip set with 256K of VRAM; it provides for simultaneous external display of up to 800-by-600 resolution at 256 colors.

On PC Magazine Labs' tests, the Jetbook was stunning across the board: it came in second of all the notebooks tested on the DOS processor test (due in part to the 32K SRAM write-through cache) and placed third overall on both Windows tests. The Battery Rundown score (almost 3 hours) was solid; the ZDi-

The Jetta Jetbook 486DX/33

SUITABILITY TO TASK

Jetta Jetbook 486DX/33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

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PC WEEK

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— *PC Week*, October 5, 1992

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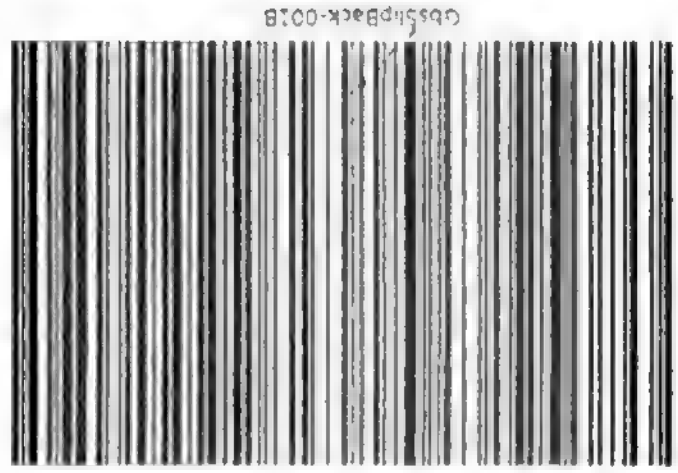
1. Follow instructions on the other side



Back

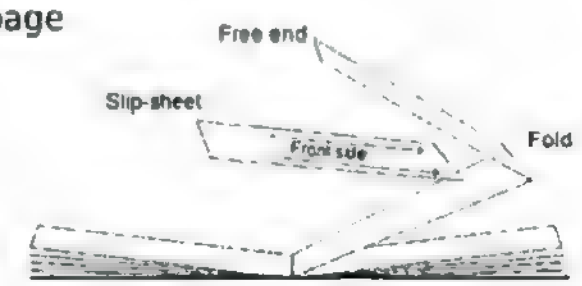
1. Follow instructions on the other side

Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

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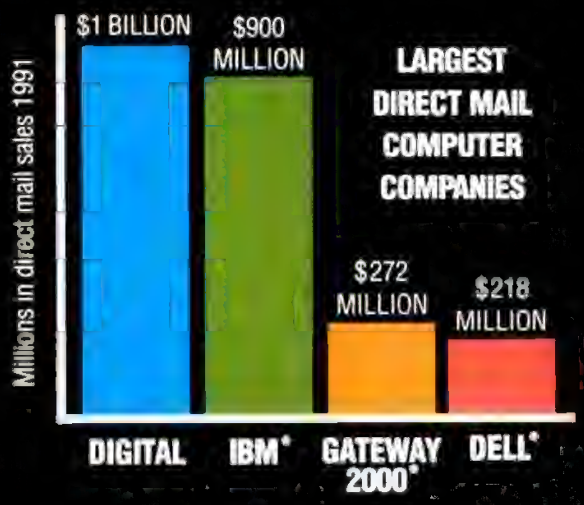
— *USA Today*, August 7, 1992



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The Outlook on Professional Computing
August 24, 1992

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FACT FILE

Jetta Jetbook 486DX/33

Jetta International Inc., 45 Stouts Ln., #5, Monmouth Junction, NJ 08852; 908-329-9651; fax, 908-329-0105

List price (tested configuration): $2,598.
Tested configuration: 4MB RAM, 80MB Toshiba IDE hard disk, 1.44MB floppy disk drive, DOS 5.0.
Options: 4MB RAM upgrade, $345; 125MB Toshiba hard disk, $250; 9,600/2,400-bps send/receive fax modem, $195; docking station, $395; external 1.2MB floppy disk drive, $195.
In short: The Jetbook 486DX/33 delivered stunning performance but had minor design flaws.
$30 ON READER SERVICE CARD

git result (3 hours 15 minutes) was just shy of the 3.5-hour rating.

The 84-key keyboard has cursor keys arranged in an inverted T and separate PgUp, PgDn, Home, and End keys; the function keys are half-size. An optional trackball costs $145. The Jetta's docking station is designed to facilitate using your laptop in the office; for instance, it helps provide quick access to a LAN. It has all of the necessary ports, two 16-bit slots, and two internal drive bays.

The warranty is the standard one year on parts and labor.—*CK*

Keydata International Inc.

Keynote 386SX-25
Keynote 486SLC

The $1,595 Intel-based Keynote 386SX-25 and the $1,875 Cyrix-based Keynote 486SLC performed well on PC Magazine Labs' tests and had decent battery longevity, but both models had problems with display failure. Until these screen bugs are worked out, think twice, regardless of price.

The 486SLC 25-MHz Cyrix CPU pushed the Keynote to above-average processor, memory, and video performance, while its 386SX/25-based cousin achieved above-average scores on our processor and memory tests. The disappointment for both units was the video. The 9.5-inch Sanyo screen can display up to 16 gray shades, but we experienced failures on both systems reviewed, raising questions about conflicts between the Chicony motherboard, the Cirrus controller, and the Sanyo screen.

The Keynotes also use the same keyboard, although the higher-powered model includes a built-in trackball on the upper-left side of the keyboard; unfortunately, the trackball Select and Enter buttons were very stiff. The 386SX-25 notebook gets by with a Genius HiPoint clamp-on mouse, which is a compromise travel convenience.

At 8.4-pounds traveling weight, the Keynote 386SX-25 is a bit heavy for a notebook; the system's 8.3- by 11.3- by 2-inch dimensions are also on the high side for current notebooks. The higher-powered Keynote 486SLC is slightly smaller (1.9 by 11.8 by 8.3 inches) and at 8.3-pounds, a touch lighter.

Battery life was marginally better for the 486SLC system; it lasted 2 hours 7 minutes on the Battery Rundown test, compared to 1 hour 58 minutes for the 386SX-25. The low-end machine's power-management options consist solely of a standby power mode that is configured via a utility diskette.

The Keynote 486SLC has a full set of power-management features, which are enabled via the CONFIG.SYS file. There is a Windows power-management feature, but it requires you to manually edit the Windows SYSTEM.INI file—not atask for computer novices.

You can also install an internal modem in the 486SLC, which in combination with the built-in trackball, lighter weight, smaller size, and longer battery life makes this computer a better candidate for the road than the 386SX-25.

The Keynote 386SX-25 and the Keynote 486SLC

SUITABILITY TO TASK

Keynote 386SX-25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

Keynote 486SLC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Keynote 386SX-25

Keynote 486SLC

Keydata International Inc., 111 Corporate Blvd., S. Plainfield, NJ 07080; 800-486-4800

List price (test configuration): $1,595 (386SX-25); $1,875 (486SLC).
Tested configuration: 5MB RAM, 80MB Connor hard disk, Genius mouse, 2,400-bps fax modem (386SX-25). 4MB RAM, 80MB Seagate hard disk, internal trackball (486SLC). 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.
Options: 2MB RAM upgrade, $160; 8MB RAM upgrade, $420; 125MB hard disk, $100; 9,600-bps data/fax modem, $165 (486SLC). numeric keypad, $60; extra battery, $85; additional AC adapter, $125.
In short: Both models performed well and had decent battery longevity but suffered from display failure.
$30 ON READER SERVICE CARD

Keydata's service and support mix is the same for both systems. The company's standard one-year parts-and-labor warranty is backed by a toll-call technical support number and manufacturer service. There is no on-site service available for the Keydata notebooks.

Especially with the troublesome screens, you should pass by the Keydata systems to find one that's more reliable and won't require toll calls and shipping for repair.—*BB*

Leading Edge Products Inc.

Leading Edge N3/SL25 Plus

Just when you thought notebooks were getting smaller, along comes the Leading Edge N3/SL25 Plus, which stretches the accepted boundaries. It measures 2 by 13.5 by 8.6 inches and weighs 8.1 pounds with its nickel cadmium battery and AC adapter. The extra width was put to good use by including a numeric keypad, large trackball and a 2,400-bps modem with

The Leading Edge N3/SL25 Plus

SUITABILITY TO TASK

Leading Edge N3/SL25 Plus

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

4,800-bps send-only fax capability. At $2,499, the N3/SL25 Plus comes with 4MB of 70-ns RAM, a 32K SRAM cache, an 85MB Conner IDE hard disk, and an edgelit 9.5-inch TSTN screen. Memory is upgradable to a maximum of 8MB through an easy-to-access panel on the top of the notebook, and the hard drive can be upgraded to 120MB.

The Leading Edge's performance proved average across all our tests. It supports an external display at 800-by-600 resolution, but not simultaneously.

The battery is large and the power-conservation features are numerous, with video, hard disk, and serial port power-downs, global standby, and automatic system suspend. We were disappointed with its times of 1 hour 22 minutes on the Battery Rundown test and 1 hour 51 minutes on the ZDigit test.

The 100 keys (including the separate numeric keypad) are full-sized and have a comfortable feel. There are separate PgUp, PgDn, Home, and End keys and an inverted-T cursor layout. The function keys are slightly smaller than full-size but are quite usable. The keypad feel is a bit springy. The warranty covers parts and labor for one year. The company offers toll-free technical support as well as BBS support.—*Rich Fisco*

FACT FILE

Leading Edge N3/SL25 Plus
Leading Edge Products, Inc., 117 Flanders Road, Westborough, MA 01581; 800-874-3340, 508-836-4800, fax, 508-836-4504

List price(tested configuration): $2,499.
Tested configuration: 4MB RAM, 85MB Conner IDE hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows 2.0, 2,400-bps MNP 5 send-only fax modem.
Options: 6MB RAM upgrade, $499; 120MB hard disk, $200; extra battery, $119.
In short: This larger notebook might be attractive if not for its poor battery performance and ergonomics.
540 ON READER SERVICE CARD

Librex Computer Systems Inc.

Librex T386SX

The $2,499 Librex T386SX is a little heavy to be true subnotebook but has an external floppy disk drive.

The T386SX's case measures only 1.5 by 11.7 by 8.5 inches and weighs slightly over 5 pounds with its nickel cadmium battery installed. The 1.44MB floppy disk drive attaches to the left side via a cable

The Librex T386SX

that might prove to be too weak. A PCMCIA expansion slot on the right is capable of holding additional memory or an internal modem.

SUITABILITY TO TASK

Librex T386SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Although the keys are a little thin, their resistance and feedback are good. The battery, held in by easy-to-open latches, was one of the easiest to change.

This 386SX/20 T386SX can hold between 4MB and 12MB of RAM (but lacks an external processor RAM cache) and came with a Toshiba 40MB IDE hard disk and a Cirrus Logic chip set with 256K of video DRAM. This lets the T386SX display Super VGA with 16 colors externally while simultaneously running the VGA Sanyo edgelit LCD panel. The T386SX doesn't have an internal pointing device, but the company includes a copy of QAPlus.

Because there are only two 386SX/20 products in this review, it is unfair to compare their performance, although the T386SX/20's scores were midrange in the 386SL/20 group in all categories. Battery times were acceptable, at 2 hours 23 minutes without power conservation and a slightly disappointing 3 hours 30 minutes with power conservation.

The T386SX comes with a one-year parts-and-labor warranty and on-site service. Keep in mind that Librex is closing its doors in April 1993.—*OR*

FACT FILE

Librex T386SX
Librex Computer Systems Inc., 1140 Ringwood Ct., San Jose, CA 95131; 800-248-4880; fax, 408-432-6126

List price (tested configuration): $2,499.
Tested configuration: 4MB RAM, Toshiba HDT400S IDE 40MB hard disk, DOS 5.0, external 1.44MB floppy disk drive..
Options: 80MB hard disk, $999; 2MB RAM upgrade, $229; 4MB RAM upgrade, $459; 8MB RAM upgrade, $999; PCMCIA fax modem card, $499.
In short: The T386SX offers decent performance in a slim, trim package.
541 ON READER SERVICE CARD

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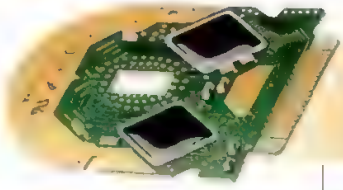

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*See dealer for warranty details. ML590 shown with optional bottom-feed push tractor and stand. OKIDATA, MICROLINE and the OKI OK! are Registered Trademarks and OKISMART Paper Handling is a Trademark of Oki Electric Industry Co., Ltd. "We don't just design it to work. We design it to work wonders." is a RegisteredTrademark of Oki America, Inc.

CIRCLE 235 ON READER SERVICE CARD

Librex Computer Systems Inc.

Librex R386SL

Librex is closing in April 1993, and the company has decided to go out with a bang. Its $2,499 Librex R386SL is an easily upgradable and sturdily constructed machine full of practical innovations.

The 2-by 11.7-by 8.5-inch case weighs 6.7 pounds. Once it's open, you will see an internal power switch and a mini-LCD

The Librex R386SL

panel that shows 13 important functions. To the left of that, you will encounter the first surprise: a decent integrated trackball. It attaches to either the case's right or left side. Remove the floppy disk drive if you want to insert a third battery, which extended operation to slightly over 5 hours on our Battery Rundown test.

Inside this 386SL/25 you can install between 2MB and 20MB of system RAM, but no external cache. The test unit held a Conner IDE 80MB hard disk and a Western Digital chip set with 256K of video DRAM.

The R386SL was no slouch, turning in competitive numbers across the board. Battery times were disappointing with the system's normal battery array: 1 hour 35 minutes (extended to a whopping 5 hours 2 minutes with the additional battery). Its ZDigit Rundown score was also average: 2 hours 48 minutes (extended to 7 hours 16 minutes with the third battery). Power-saving features are stingy, with only LCD and hard disk power-downs and a CPU sleep mode. Also, the setup screen can be reached only from the DOS prompt.

The R386SL comes with a one-year parts-and-labor warranty and free on-site service during that year; of course, what happens after April 1 is anybody's guess.—*OR*

SUITABILITY TO TASK

Librex R386SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Librex R386SL

Librex Computer Systems Inc., 1140 Ringwood Ct., San Jose, CA 95131; 800-248-4880; fax, 408-432-6126

List price (tested configuration): $2,499.

Tested configuration: 4MB RAM, Conner IDE 80MB hard disk, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive, Western Digital video chip set with 256K video memory, Seiko TSTN backlit LCD.

In short: The Librex R386SL is well designed and marvelously practical, though its price tag is slightly high. A caveat: The company is expected to go out of business a few months from now.

542 ON READER SERVICE CARD

Matrix Digital Products Inc.

Matrix 486SX-25Mhz Notebook

Mitsuba Corp.

Mitsuba Ninja 486SX

The Matrix 486SX-25Mhz and Mitsuba Ninja 486SX are exact duplicates of each other. The only differences appear to be lower performance numbers for the Ninja product and a higher price for the Mitsuba unit. When it comes to solidity of construction and features, however, both systems share a particular similarity: Both come up slightly short.

They also are somewhat disappointing when cost is considered. At $1,995 for the Matrix and $2,149 for the Ninja, these are average contenders when examined from the vantage point of price, as well as performance.

Dressed in beige 2- by 11- by 8.75-inch cases, these notebooks each weigh 6.8 pounds. Most other case features are average: I/O ports are rear-mounted behind a typical plastic flip-down door, and the internal floppy disk drive is side-mounted, as is the power switch (which isn't recessed in the Ninja as it is in the Matrix). The Ninja's screen is loosely attached, but the AC adapter brick is small and light.

Like the Matrix's keyboard, the Ninja's keyboard is truly annoying. Aside from little key travel or tactile feedback, the up-arrow cursor key is positioned where a Shift key would normally be.

Internally, the two systems are virtually identical as well. The Award BIOS, in addition to an Intel 486SX/25 processor minus an external system RAM, dominates in both systems. The same Toshiba 80MB IDE hard disk and a Cirrus Logic video chip set with 256K of video

SUITABILITY TO TASK

Matrix 486SX-25Mhz Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

SUITABILITY TO TASK

Mitsuba Ninja 486SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

The Matrix 486SX-25Mhz Notebook and the Mitsuba Ninja 486SX

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FACT FILE

Mitsuba Ninja 486SX
Mitsuba Corp., 1925 Wright Ave., La Verne, CA 91750; 800-648-7822, 714-392-2000

List price (tested configuration): $2,149.
Tested configuration: 4MB RAM, Toshiba MK2024FC IDE 80MB hard disk, DOS 5.0, Microsoft Windows 3.1, Sharp TSTN backlit LCD screen, 1.44MB floppy disk drive.
Options: 4MB RAM upgrade, $267; internal send-only fax modem, $290.
In short: Although it is the same product as the Matrix machine, the Mitsuba unit significantly underperformed its twin and still carries a higher price tag.
943 ON READER SERVICE CARD

RAM are also present. Super VGA resolution in 16 colors is possible externally, and the portable can display its VGA LCD panel and run an external monitor at the same time.

But the systems' respective performance scores differed significantly. Even though both systems are essentially the same, the Matrix noticeably outperformed the Ninja. But perhaps a better way of putting it would be to say that the Ninja simply couldn't keep up. It stayed considerably behind the Matrix as well as the other eight 486SX/25-based machines we saw. The Ninja's processor, memory, DOS video, and Disk Winmark scores, in addition to its other scores, were all below the average. Even its battery test results were anomalous and inferior: 1 hour 47 minutes on the Battery Rundown test without power conservation (14 minutes less than the Matrix) and 3 hours 44 minutes on the ZDigit Rundown test with power conservation (28 minutes less than the Matrix).

Matrix Digital Products sells its notebook primarily through its own dealers and value-added resellers. The company backs its product with a one-year parts-and-labor warranty. One year of on-site service is available through Wang Laboratories for $55. Mitsuba Corp. offers a one-year parts-and-labor warranty and free first-year on-site service.—*OR*

FACT FILE

Matrix 486SX-25Mhz Notebook
Matrix Digital Products Inc., 1811 N. Keystone, Burbank, CA 91504; 800-227-5723, 818-566-8567; fax, 818-566-1476

List price (tested configuration): $1,995.
Tested configuration: 4MB RAM, Toshiba MK2024FC IDE 80MB hard disk, 1.44MB floppy disk drive, Sharp TSTN backlit LCD screen, DOS 5.0, Microsoft Windows 3.1.
Options: External 1.2MB floppy disk drive, $189.
In Short: The Matrix 486SX/25Mhz Notebook suffers from such minor failings as a flawed keyboard.
942 ON READER SERVICE CARD

Micro Express

Micro Express NP933

In our August 1992 roundup of portable PCs, Micro Express sent us its NB913. With the exception of a new, attractive $1,899 price tag and an AMD Am386DX/33 CPU, the Micro Express NP933 is basically the same machine. Its performance is attractive, but this portable is not light and is stingy on system memory.

The Micro Express NP933

A 1.8- by 12- by 9.5-inch 7.6-pound case has ports for two snap-on batteries, one of which can instead be used to connect an external floppy disk drive or Ethernet or SCSI adapters. There are parallel, serial, external VGA, and external keyboard ports. The 83-key keyboard is generously sized (almost like a standard desktop model). A handy suspend button places the system into hibernation mode.

Inside, you will find the Am386DX/33 CPU (but no external cache), and from 4MB to 8MB of RAM. You will also see a Toshiba IDE 120MB hard disk with an internal 32K buffer, and Cirrus video circuitry with 256K of DRAM. This latter component can pump out external Super VGA with 256 colors but can't drive the Sanyo backlit TSTN LCD panel and external monitor simultaneously. The unit's AC adapter brick is by no means the smallest or lightest.

SUITABILITY TO TASK

Micro Express NP933

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Micro Express NP933
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $1,899.
Tested configuration: 4MB RAM, Toshiba MK2124FC IDE 120MB hard disk, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive.
Options: 4MB RAM upgrade, $180; 2,400/9,600 fax modem, $200; Ethernet adapter.
In short: The NP933 is speedy for a 386/33-based machine and has some easy-upgrade features, but it is large and heavy.
945 ON READER SERVICE CARD

The NP933's performance was difficult to compare with that of others because ofits unique processor, though its results were competitive compared with the 486SX/25s. Its processor score was slightly below-average against the 486SX/25s, but certainly above 386SX/25s numbers. DOS video was above-average, and its disk scores were average under DOS but subpar under Windows.

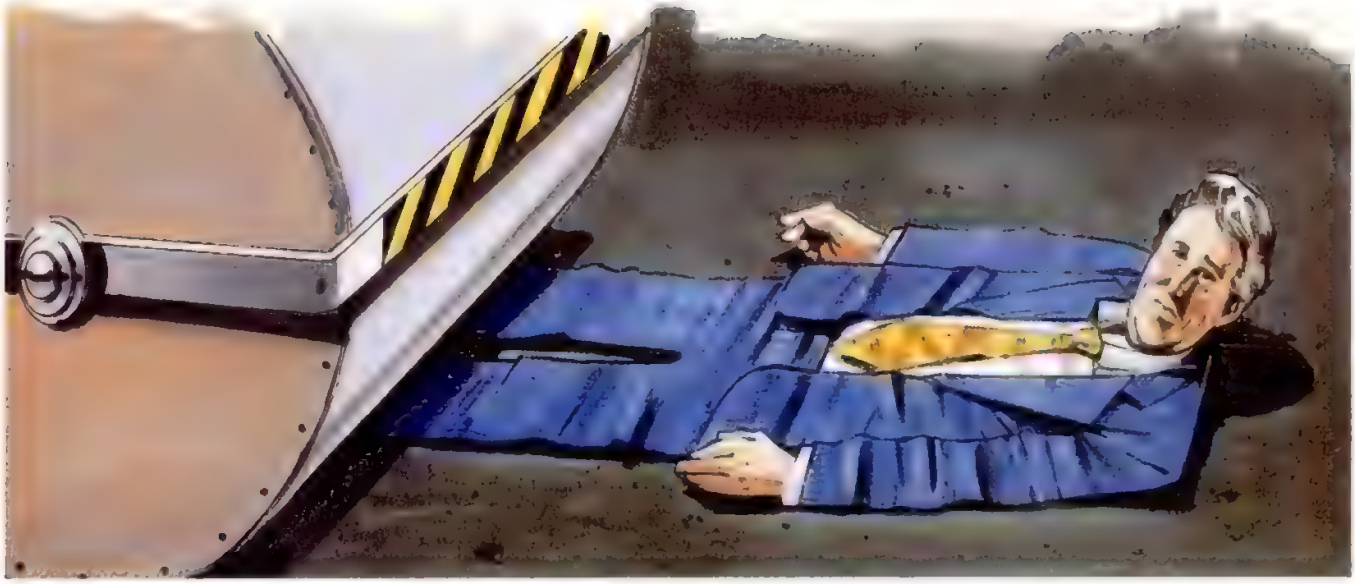
The company includes a 15-month parts-and-labor warranty with no on-site service.—*OR*

Micro Express

Micro Express NB486DX

For those who do enough heavy-duty number crunching to justify a 486DX/33 laptop, the $3,049 Micro Express NB486DX is one of the lowest-cost power-processor notebooks available, but it offers little in the way of ergonomics and amenities.

Measuring 1.5 by 11.5 by 8.5 inches,



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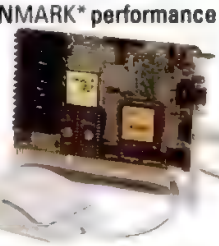

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The Micro Express NB486DX

SUITABILITY TO TASK

Micro Express NB486DX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

the NB486DX weighed 7.3 pounds with its nickel cadmium battery. The keyboard has large keys arranged in a nonstandard layout that does away with inverted-T cursor keys and separate Home, End, PgUp, and PgDn keys. A disappointment was the integrated pointing device, which was mounted on the outside of the case and required both hands to operate. Unfortunately, the system's standby-mode switch is positioned next to the mouse buttons.

Memory can vary between 4MB and 32MB, while mass storage is handled by a Toshiba IDE 120MB hard disk with an internal 32K buffer. The Cirrus chip set is capable of simultaneously running an external Super VGA monitor at 256 colors and the VGA Panasonic backlit TSTN LCD panel.

Power conservation is restricted to adjustable display and hard disk shutdowns and a standby mode. Battery times were mid-range: 2 hours 33 minutes without power conservation and 3 hours 1 minute with power conservation. Processor performance was below-average when compared with other reviewed 486DX/33 notebooks, as was its memory score. Video scores were about average under both DOS and Windows.

This PC has a 15-month warranty and a 30-day money-back guarantee.—*OR*

FACT FILE

Micro Express NB486DX
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $3,049.
Tested configuration: 8MB RAM, Toshiba MK2124FC IDE 120MB hard disk, DOS 5.0, Windows 3.1, 1.44MB floppy disk drive, 2,400/9,600-bps fax modem, Panasonic TSTN backlit LCD.
Options: Extra battery, $99; AC adapter, $150.
In short: The NB486DX is a fairly solid, no-frills portable. Its processor is one of its strong points, and it offers power at a decent price.
546 ON READER SERVICE CARD

PC&C Research Corp.

Dynova SLic3000

With a travel weight of 8.4 pounds, the PC&C Dynova SLic 3000 is on the heavy side. And with a passive-matrix monochrome screen and a battery life of 2.3 hours, it has little to justify its weight.

PC&C's Dynova SLic3000

With 82 keys, the keyboard includes separate cursor keys but, oddly, no separate PgDn or PgUp keys. Function keys, cursor keys, Ins, and Del are not full-size. The 8.8-inch-diagonal screen is sharp and clear, and controls allow users to adjust it to a variety of lighting conditions.

The power-management features take advantage of Intel's 386SL chip set, with adjustable settings for powering down the display, hard drive, and CPU. Other options include Global Standby, which slows the CPU down, and Auto suspend, which will shut down the entire system except the memory.

SUITABILITY TO TASK

PC&C Dynova SLic3000

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Dynova SLic3000
PC&C Research Corp., 1100 Avenida Acaso, Camarillo, CA 93012; 800-843-1239, 805-484-1685; fax, 805-987-8088

List Price (tested configuration): $ 2,090.
Tested configuration: 4MB RAM, 130MB Toshiba hard drive, DOS 5.0, 1.44MB floppy disk drive.
Options: 2MB RAM upgrade, $110; 220MB hard drive, $995; Windows 3.1 and PS/2 Mouse, $92; PS/2 Trackball,$79; internal 96/24 Fax Modem with Delrina WinFax, $147; Mustek hand-held scanner, $129.
In short: Average in most respects, the Dynova notebook does provide a scanner port.
547 ON READER SERVICE CARD

Average results across the board were marred by the unit's relatively low scores in terms of DOS and Windows video. The disk, memory, and CPU scores were better, but still unable to compensate.

A bright spot is the variety of options the Dynova offers. Memory can range from 2MB to 32MB; hard drives are available from 80MB to 220MB; and a fax modem can be ordered. But what separates the Dynova most from other notebooks is its Marstek/Mustek scanner port, which might appeal to graphic artists on the go. It allows users to send artwork, photos, and other images over a modem.

The Dynova comes with a one-year parts-and-labor warranty, but users must pay to ship units to dealers. Tech support is available weekdays and is toll-free outside California.—*Amarendra Singh*

Polywell Computers Inc.

Poly NB325T

The $1,695 Poly NB325T feels solid, but its performance left much to be desired.

The sleek, 6.8-pound NB325T measures 2 by 11 by 8.5 inches—a welcome departure from the lookalike clamshell case used by many other tested units. The AC adapter added 1.4 pounds to the package. The test unit included 4MB of

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CIRCLE 161 ON READER SERVICE CARD

The Poly NB325T

SUITABILITY TO TASK

Poly NB325T

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

RAM and an 86MB Toshiba hard disk.

Hidden behind well-designed flaps are two serial ports and single parallel, VGA, and keyboard ports, as well as an expansion bus. The 80-key keyboard offered the standard 12 separate function keys and an inverted-T cursor-key layout, but the Backspace, Enter, and Shift keys were on the extreme right edge—a layout which may not please everyone. Two-key combinations are needed to activate the PgDn, PgUp, Home, and End keys. The 9.5-inch CCFT display provided a good image that faded when viewed from angles. The Cirrus video chip set supports an external VGA monitor at 256 colors, but not simultaneously.

FACT FILE

Poly NB325T

Polywell Computers Inc., 61-C Airport Blvd. So., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974

List price (tested configuration): $1,695.
Tested configuration: 4MB RAM, Toshiba MK2024 80MB IDE hard disk, DOS 5.0, 1.44MB floppy disk drive.
Options: 4MB RAM upgrade, $160; additional 12MB upgrade, $400; 130MB hard disk, $150; Windows 3.1, $48; internal fax modem, $300; internal 2,400-bps MNP5 modem, $165.
In short: A good-looking, sturdy machine with good battery life, but a weak performer on PC Labs' tests.
548 ON READER SERVICE CARD

The NB325T's power conservation includes display, hard disk, and peripherals power-downs, and incremental doze, sleep, and suspend modes.

On our Battery Rundown test, the NB325T lasted a respectable 2 hours 42 minutes and logged a solid 3 hours 29 minutes on our ZDigit Rundown test. It unfortunately placed below average on our benchmark tests, posting scores that were below-average or the worst in its CPU class.

The NB325T comes with a one-year parts-and-labor warranty.—*RA*

Polywell Computers Inc.

Poly NBC25

Polywell Computers' Chaplet-made Poly NBC25 includes 4MB of RAM, a 16K external RAM cache, and an 80MB hard

The Poly NBC25

disk. And with only a 6.9-pound travel weight, including its battery and AC adapter, this notebook is a difficult bargain to resist.

The slim, 1.5- by 11.3- by 8.5-inch case slips easily into attache cases and portfolios. The NBC25 feels quite sturdy, and the little doors that open to expose the video, parallel, and serial ports are attached firmly to the case.

This notebook turned in average processor, memory, and disk benchmark test scores and very slow video scores. The Poly NBC25 lasted 2 hours 35 minutes on our Battery Rundown test—a performance that significantly surpassed the performances of its sister machine. . Its ZDigit Rundown score was 3 hours 10 minutes with its power conservation enabled (this included three levels of system shutdowns, and hard disk power-downs).

The 9.5-inch-diagonal backlit LCD panel supports VGA with 64 shades of gray. The notebook's video subsystem

SUITABILITY TO TASK

Poly NBC25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Polywell Poly NBC25

Polywell Computers Inc., 61-C Airport Blvd., S. San Francisco, CA 94080, 800-999-1278; 415-583-7222

List price (test configuration): $1,770
Tested configuration: 4MB RAM, 80MB Conner CP2088 hard disk, DOS 5.0, Microsoft Windows 3.1, 1.44MB floppy disk drive.
Options: 2MB RAM upgrade, $125; 130MB hard disk, $175;2,400/9600-bps send-only data fax modem, $130.
In short: The Poly NBC25 offers low weight and price plus adequate performance.
549 ON READER SERVICE CARD

can simultaneously run an external VGA monitor.

The 86-key keyboard has 8 separate cursor-movement keys and 10 half-height function keys. An Fn key activates an embedded numeric keypad and alternate function-key assignments, such as accessing the system's CMOS power-management utility. The integrated trackball means you don't need to carry a mouse with you.

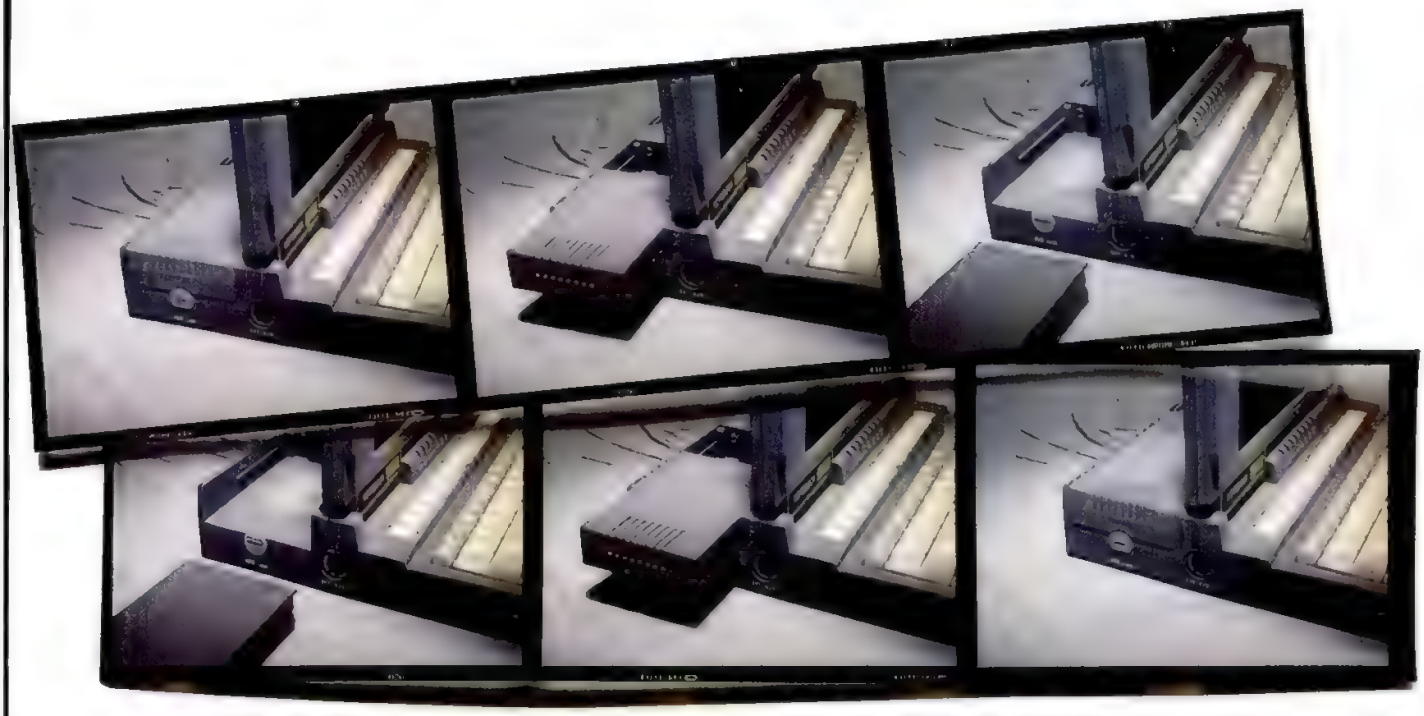
Polywell Computers covers the Poly NBC25 with a one-year warranty on parts and labor; it doesn't offer on-site service, but it does offer toll-free technical support six days a week, and a 30-day money-back guarantee. Buyers must pay for shipping to the manufacturer for warranty repairs.—*BB*

Primax Corp.

Primax Eagle 425SX

The inexpensive $1,995 Primax Eagle 425SX offers power at a micro price, but at a cost in portability. With a travel weight of 8.1 pounds, the Eagle arrived with an Intel 486SXLP/25 CPU, 4MB of RAM (expandable to 20MB), an 80MB

Trade memories with your friends.



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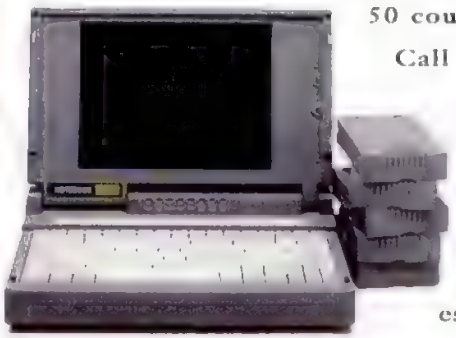

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CIRCLE 099 ON READER SERVICE CARD

Conner IDE hard disk, and DOS 5.0. The Primax Eagle's solid performance, 2 hour 44 minute Battery Rundown score, warranty, and friendly layout make it a powerful, practical buy.

The Primax Eagle 425SX

The 1.4-pound nickel hydride battery pops out when you push two release buttons on the bottom of the case and lift the keyboard. By next opening an interior panel, the user can install additional RAM modules. The 1.8- by 11- by 8.6-inch Eagle's video subsystem included a Cirrus chip set with 256K of VRAM and a Sharp 9.5-inch-diagonal TSTN backlit screen. Brightness and contrast control is adjustable only via function key commands.

The Eagle's performance was enviable, as it ranked in the top third of all the notebooks reviewed here. Its Disk Winmark score, however, was the lowest in its processor class. Power conservation consisted of adjustable display, hard disk, and standby power-downs.

Twelve half-size function keys border the top of the 82-key keyboard. The cursor keys, in an inverted-T layout, double as Home, PgUp, PgDn, and End. The Eagle also has separate phone and line jacks, and it can hook up to an expansion station. A 2,400/9,600-bps send/receive fax modem is available for $299.

Primax Corp. offers a one-year parts warranty and two-year labor warranty but no on-site service. Technical support may be reached weekdays.—*CNC*

SUITABILITY TO TASK

Primax Eagle 425SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Primax Eagle 425SX
Primax Corp., 5450 NW 33rd Ave., #101, Fort Lauderdale, FL 33309; 800-949-8088

List price (tested configuration): $1,995.
Tested configuration: 4MB proprietary RAM, 80MB Conner IDE hard disk, DOS 5.0, 1.44MB floppy disk drive.
Options: 4MB RAM upgrade, $199; additional 8MB RAM upgrade, $400; 120MB hard disk, $219; Microsoft Windows 3.1, $90; 2,400/9,600-bps send/receive fax modem, $299; 2,400-bps fax modem, $119.
In short: One of the least expensive 486s in this roundup, the computer falls short on portability.
564 ON READER SERVICE CARD

Primax Corp.

Primax NightHawk 325SXL

At $1,584, the Primax NightHawk 325SXL is one of the lowest-priced laptops in *PC Magazine*'s portables roundup, and for good reason. The travel weight of 7.8 pounds coupled with the battery's rundown time of 1 hour 33 minutes encourages a NightHawk owner to stay close to home.

The Primax NightHawk 325SXL

Powered by an AMD Am386/25 processor, the NightHawk comes with 4MB of proprietary SIMMs, a 60MB Seagate IDE hard disk, DOS 5.0, and Windows 3.1. Its gray 2.5- by 11.5- by 8.5-inch case weighs 6.5 pounds with battery. By removing three screws in the case and lifting the keyboard, you can upgrade RAM by inserting proprietary memory modules (expandable to 8MB). Except for its exceptional performance on our Graphics Winmark test, the NightHawk garnered scores on the low side of average.

SUITABILITY TO TASK

Primax NightHawk 325SXL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Primax NightHawk 325SXL
Primax Corp., 5450 NW 33rd Ave. # 101, Fort Lauderdale, FL 33309; 800-949-8088

List price (tested configuration): $1,584.
Tested configuration: 4MB RAM, 60MB Seagate ST90968 IDE hard disk, DOS 5.0, 1.44MB floppy disk drive, math coprocessor.
Options: 4MB RAM upgrade, $99; 120MB hard disk, $219; Microsoft Windows 3.1, $90; 2,400/9,600-bps send/receive fax modem, $119; Ethernet adapter, $319; Token-Ring adapter, $549.
In short: Its price is low, but its weight and battery life make it less than ideal for travel.
560 ON READER SERVICE CARD

Battery Rundown and ZDigit test performances were also poor, despite the NightHawk's numerous power-conservation features.

The NightHawk's 85-key keyboard included 12 half-size function keys and an inverted-T cursor pad. Unlike its relative, the Primax Eagle 425SX (also reviewed here), this unit has separate Home, End, PgUp and PgDn keys. The NightHawk's 1.44MB floppy disk drive is located in the front, which is a bit inconvenient. Similarly awkward is the placement of the battery, which could only be removed by first opening a side panel and pressing a button inside, which releases the pack from the bottom of the unit.

The warranty covers parts for one year and labor for two, but Primax does not offer on-site service.—*CNC*

QSI Corp.

Klonimus Lite 386SL/25

QSI Corp.'s $2,289 Klonimus Lite 386SL/25, based on the AMD Am386SXL/25 processor, is larger than most of the competition. And at 7.5 pounds with its two

"No matter how much we grow, we know we can bank on the LANtastic networking system."

MIS Manager Nola Matthews and Tracy Schmidt, VP of Operations, First Interstate Bank of South Dakota, N.A.

THE BIG SWITCH
INTERVIEW #5:

In the summer of 1991, the Credit Card Division of First Interstate Bank of South Dakota needed to network 10 computers. Since they already had an open Novell® license, their first inclination was to go with Novell. But Sandy Silverberg, of **Ideasign Computers**, an Artisoft Authorized Five Star℠ dealer, urged them to check out the LANtastic® networking system. Since a neighboring department was running a Novell NetWare® network (v2.15) and another department was running a LANtastic network, comparisons were easy. They chose the LANtastic system and are now up to **100 nodes** – and growing. Why did they choose LANtastic?

"Our primary considerations were the LANtastic system's peer-to-peer capabilities, its ability to interface with our mainframe, the ease of its installation and maintenance and the significant cost-savings over Novell," says Tracy Schmidt, VP of Operations. **"The installation turned out amazingly fast and simple. I left work at 7:00 one evening with no network and when I came in the next morning, our people were already signed on and productive."** Nola Matthews, MIS Manager, says, "The system has been extremely reliable and we have received excellent, unlimited and free technical support from Artisoft. We are using two 3270 gateways, which provide us with up to 80 simultaneous sessions on a mainframe. From its low cost to its reliability to its ease of use, our LANtastic network has proved to be a complete and remarkable package."

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CIRCLE 254 ON READER SERVICE CARD

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A COMPARISON THAT SCARES THEM TO DEATH

InfiniType Plus v. the Big Typeface Companies	Us	Them
Font Quality	Superior	Superior
Cost	$99.95	Expensive
Format	PostScript and TrueType	One or the other, not both
Scaling Engine	Yes	No (if yes, fewer faces)

InfiniType Plus v. the Little Typeface Companies	Us	Them
Font Quality	Superior	Inferior
Cost	$99.95	Comparable
Format	PostScript and TrueType	One or the other, not both
Scaling Engine	Yes	No (if yes, fewer faces)

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Headline font: Sans Black Text font: Garamond

CIRCLE 212 ON READER SERVICE CARD

QSI's Klonimus Lite 386SL/25

SUITABILITY TO TASK

Klonimus Lite 386SL/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

nickel cadmium batteries installed, it is a bit heavier as well.

The 1.7- by 12- by 9.5-inch Klonimus we tested came with 4MB of RAM and a 120MB Toshiba hard disk. For $220 less, you can purchase it with an 80MB hard disk. The 9.5-inch-diagonal Sanyo LCD panel is backlit and can display 64 shades of gray in crisp resolution. Unfortunately, the screen does not lay flat, and the Headland Technology video chip set is not capable of simultaneously displaying the LCD panel and an external monitor.

The six AMD Am386SXL/25 notebooks reviewed showed considerably erratic performance, and the Klonimus was no exception. Its disk scores under both DOS and Windows were bottom-rung, and its video score was nearly the lowest in this CPU class. However, its memory score was high, and its processor score respectable. Battery life results were also admirable; a second battery adds a little less than a pound to the machine, but the extra weight was justified by the unit's 3-hour 45-minute Battery Rundown time without power conservation. On our ZDigit Rundown test, it lasted almost 4.5 hours with power conservation.

Motherboard memory is upgradable to 8MB, at $100 per 2MB unit. Upgrading memory, however, requires removing the keyboard and adding ZIP modules. Behind one battery is a port for an expansion bus that can take a $165 Ethernet adapter, while behind the other is a port for an optional $240 external floppy disk drive.

The Klonimus comes with a one-year parts-and-labor warranty.—*BG*

FACT FILE

Klonimus Lite 386SL/25
QSI Corp., 95 Rockwell Place, Brooklyn, NY 11217; 800-347-5500, 718-834-4545

List price (tested configuration): $2,289.
Tested configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, Sanyo triple supertwist backlit LCD, DOS 5.0, Microsoft Windows 3.1.
Options: 2MB RAM upgrade, $100; external keyboard, $33; external floppy disk drive, $240; Ethernet adapter, $165; extra battery, $65; car battery adapter, $25; battery charger, $95, 9,600/2,400-bps fax modem, $169;
In short: Large and heavy, the Klonimus does have a readable screen and long battery life.
501 ON READER SERVICE CARD

Samsung Electronics America Inc.

NoteMaster 386L/25

Samsung's $2,399 NoteMaster 386L/25 is highly portable, feature-rich, and a decent performer. The 1.8- by 11- by 8.5-inch 386SL/25 weighs just 5.8 pounds with its nickel cadmium battery, and contains 4MB of RAM, and a 60MB Conner hard disk.

Samsung's NoteMaster 386L/25

There are plenty of power-management features with the NoteMaster: programmable display, hard disk, and CPU power-downs, along with standby and suspend modes, and a resume calendar that awakens the unit on a specific date.

SUITABILITY TO TASK

NoteMaster 386L/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

NoteMaster 386L/25
Samsung Electronics America Inc, 105 Challenger Rd., Ridgefield Park, NJ 07660-0510; 800-446-0262

List price (tested configuration): $2,399.
Tested configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.
Options: 2MB RAM upgrade, $349; 6MB RAM upgrade, $949; 80MB hard disk, $200; external keyboard, $99; numeric keypad, $99; 2,400-bps modem, $249; 2,400 fax modem, $399; 9,600-bps fax modem, $399.
In short: The NoteMaster is feature-rich, but suffers from a short battery life.
502 ON READER SERVICE CARD

The keyboard has a very responsive feel, half-size function keys, cursor keys in an inverted-T layout, and an embedded numeric keypad. There is also an internal mouse which is controlled with the cursor keys and can be enabled or disabled with an Fn key combination.

The 9.5-inch-diagonal Sharp edgelit screen is adequate, but the NoteMaster gains points for its Western Digital video chip set, capable of simultaneous external VGA display with 256 colors. In addition, the Samsung sells a $199 DriveMaster kit that allows users to remove the hard disk for installation in their desktop PC.

Performance figures for the NoteMaster were very respectable. The unit pulled down a high DOS video score and commendable Windows graphics scores. One drawback, however, was its Battery Rundown score of 1 hour 29 minutes; the NoteMaster could not run our ZDigit Rundown test.

The one-year warranty may come in handy since the unit shipped to PC Magazine Labs failed completely near the end of testing. There is an optional $25program that provides expedited service. If you ship your NoteMaster to Samsung for service, it will remove your hard disk and install it in a loaner unit that will be sent to you overnight.—*BG*

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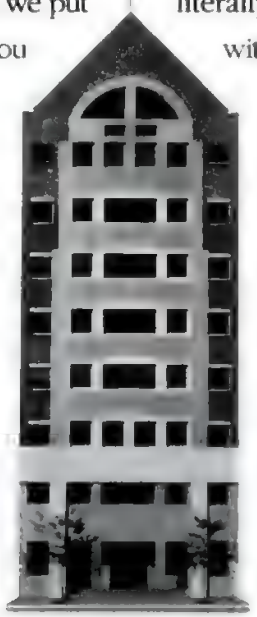

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CIRCLE 137 ON READER SERVICE CARD

Tandy Corp.

Tandy 3800 HD

The Tandy 3800 HD is a minimalist notebook priced at $2,559. It holds only 4MB of RAM, and Tandy doesn't offer a hard disk larger than 60MB. Though based on a Cyrix Cx486SLC CPU, it runs at only 20 MHz; the other Cyrix-based notebooks reviewed here run at 25 MHz. But its cost includes a 2,400/9,600-bps fax modem, which may be incentive enough.

At 1.6 by 12 by 10 inches, the Tandy 3800 is slightly large but makes up for this with a 6.8-pound travel weight. The AC adapter plugs directly into the wall, making use of the rest of the outlet difficult. The edgelit 9-inch-diagonal Sharp screen lets you control the brightness but not the contrast. A major oversight is the lack of a VGA port, which means this system can't use an external monitor.

With no other 486SLC/20 machines in the roundup, it was difficult to draw comparisons, but on our DOS benchmark tests, the Tandy 3800 ranked among the Intel-based 386SL/20 notebooks. Its fin-

The Tandy 3800 HD

est performance was on the memory test, where it compared admirably with the 386SL/25s. Battery life was respectable too: It lasted 2 hours 26 minutes on the Battery Rundown test and 2 hours 48 minutes on our ZDigit Rundown test.

The Tandy 3800 is a very basic machine with a minuscule upgrade path. It ships with Microsoft QBasic and America On-Line, as well as DOS 5.0 and Microsoft Windows 3.1. Tandy offers a one-year parts-and-labor warranty, and you can take the unit to any Radio Shack for repair. You can purchase extended warranty contracts at a discount.—*BG*

SUITABILITY TO TASK

Tandy 3800 HD

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

FACT FILE

Tandy 3800 HD

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011

List price (tested configuration): $2,559.

Tested configuration: 4MB RAM, 60MB Conner hard disk, 2,400/9,600-bps fax modem, DOS 5.0, Microsoft Windows 3.1, Microsoft QBasic, America On-Line.

Options: Extra battery, $99.95; battery charger, $229.95; nylon carrying case, $39.95.

In short: The Tandy 3800 HD is a minimalist notebook that can't be upgraded past 4MB of RAM and has no VGA port for an external monitor; but it does include a 9,600-bps fax modem.

953 ON READER SERVICE CARD

Texas Instruments Inc.

TI TravelMate 4000 WinSX/25
TI TravelMate 4000 WinDX/25

Texas Instruments has updated its TravelMate line with the 4000 series. The TI TravelMate 4000 WinSX/25 and TI TravelMate 4000 WinDX/25 are identical in every respect except for their CPUs: The first has a 486SX/25, while the other has a full-blown 486DX/25 processor. The price difference is also fairly small. The units cost $2,799 and $3,299, respectively.

Both have the same LCD panel—which can display 64 shades of gray—a 120MB hard disk, and 4MB of memory. They also share the same case design, which approximates the footprint of an 8.5- by 11-inch sheet of paper. I/O ports are protected by a hinged hatch, and the power switch is

SUITABILITY TO TASK

TI TravelMate 4000 WinSX/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

TI TravelMate 4000 WinDX/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

covered by the case when closed. The compact design brings their weight to just over 5.5 pounds each, and with the AC adapter, each has a travel weight of just under 7 pounds.

Because the only difference between the two models is the processor, you might expect their performances on our tests to be similar. This turned out to be the case, and their almost identical scores are near the top of their respective processor classes. As a result, you may not want to pay more for the DX model unless you need the built-in math coprocessorprovided by that chip.

Both machines lasted about 3.5 hours without power conservation, well above the average. With power management, the WinDX/25 managed to eke out nearly an additional hour on our ZDigit Rundown test but the WinSX/25's time improved only 13 minutes. You can get plenty of work done with a full charge.

One drawback of the small case is that the keyboard is somewhat cramped. The Esc, function, and cursor keys are tiny

The TI TravelMate 4000 WinSX/25 and TI TravelMate 4000 WinDX/25

FACT FILE

TI TravelMate 4000 WinSX/25

TI TravelMate 4000 WinDX/25

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; 800-527-3500; 817-771-5856

List price (tested configuration): TI TravelMate 4000 WinSX/25, $2,799; TI TravelMate 4000 WinDX/25, $3,299.

Tested configuration: 4MB RAM, 120MB Seagate hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $299; numeric keypad, $69; 2,400-bps fax/data modem (send-only), $299; 9,600-bps/14.4-Kbps fax/data modem, $699; extra battery, $99; battery charger, $199; Ethernet adapter, $499; Token Ring adapter, $499; SCSI adapter, $399.

In short: Compact and lightweight, the TravelMates deliver on performance and battery life.

864 ON READER SERVICE CARD

slivers compared with the other standard-size keys. The cursor keys are in an inverted-T layout, but they serve double duty as PgUp, PgDn, Home, and End through the use of an equally small function Shift key, which has the same sliver shape. There is no integrated pointing device, but a TravelPoint trackball is included with both computers.

Texas Instruments does not offer toll-free technical support, but you can get support via a toll call five days a week, and the support representatives will call you back at the company's expense. The computers come with a one-year warranty on parts and labor; on-site coverage is available as a $120 option. These two machines are attractive and powerful, but make certain that the keyboard layout suits you before settling on either of these.—*AP*

The Toshiba Satellite T1800

Toshiba America Information Systems Inc.

Toshiba Satellite T1800

The $1,999 Toshiba Satellite 1800 is Toshiba's answer to the PC price war. When you compare Toshiba's monochrome 386SX/20 with its closest rivals, the Compaq Contura models, you may find the contest too close to call.

The Conturas are slimmer and lighter, and now that they are being sold with a modem, both the Compaq and the Toshiba models are about equally functional.

The first place where you notice the attention to design is the exterior, which features rounded corners, sturdy construction, and the same off-white color that marks all Toshiba portables. The 2- by 11.5- by

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8-inch Satellite, however, is a little large, and with a weight slightly over 7 pounds with its battery, this portable isn't exactly light.

The I/O ports are behind a sliding door. When you open the screen cover, you find the same excellent 82-key keyboard for which Toshiba is justly famous. The unit's nickel cadmium battery fits easily into the case, and the small, light AC adapter uses a two-prong plug. Internally you will find an Intel 386SX/20 processor that runs under Toshiba's own BIOS, as well as between 2MB and 10MB of system RAM. However, there is no external processor cache, and the Toshiba 60MB IDE hard disk has no internal buffer. And although Toshiba has used its own video chip set along with 256K of dedicated DRAM, it did not design this portable PC for simultaneous internal and external display.

SUITABILITY TO TASK

Toshiba Satellite T1800

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

You can see where Toshiba cut a few corners to keep the price down: the Satellite has a greater number of fixed-interval power-management features than user-adjustable ones and comes with a smaller hard disk and processor than other company products. But Toshiba seems to have balanced the line between functionality and low-end cost considerations.

Because there was only one other 386SX-based PC in this review, the Librex T386SX, we compared the Satellite's performance with those in the Intel 386SL category. The Satellite placed average or well above the average on all our tests. Battery times were a pleasing 3 hours 18 minutes without power conservation on our Battery Rundown test and almost an hour longer—4 hours 13 minutes—on our ZDigit Rundown test with power-conservation features enabled.

A one-year parts-and-labor warranty accompanies the Satellite. Toshiba dealers provide on-site service.—*OR*

FACT FILE

Toshiba Satellite T1800

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-587-6034

List price (tested configuration): $1,999.

Tested configuration: 4MB DRAM with 64K external processor cache, 60MB Toshiba IDE hard disk, 1.44MB floppy disk drive, Toshiba chip set with 256K video DRAM, sidelit Toshiba STN LCD, DOS 5.0.

Options: 2MB memory card, $299; 4MB memory card, $398; 8MB memory card, $799; 1.2MB floppy drive, $399; external keyboard, $159; numeric keypad, $79; battery charger, $289; extra battery pack, $98; 2,400-bps modem, $199; internal 2,400/9,600-bps data/fax modem, $329; 2,400-bps V.42 bis MNP 5 modem, $259; AXSYS cellular interface, $219; universal AC adapter, $98; car battery adapter, $139; leather executive portfolio, $105; leather attache, $149; leather carrying case, $239; fabric carrying case, $79.

In short: The Satellite T1800 is Toshiba's successful foray into the low-cost end of the portables market. It finely balances functionality and price and is worth a closer look.

985 ON READER SERVICE CARD

Toshiba America Information Systems Inc.

Toshiba T3300SL

In our August 1992 roundup of portable systems, the $3,598 Toshiba T3300SL won an Editors' Choice award. A few months later and after about an $800 price drop, it's still a diamond.

At 6 pounds, this 386SL/25 came with 6MB of RAM (expandable to 16MB),

The Toshiba T3300SL

and a 120MB hard disk. There is a full complement of I/O ports, including parallel, serial, external VGA, mouse, keyboard, and numeric keypad ports, as well as a port for Toshiba's Desk/Station IV

SUITABILITY TO TASK

Toshiba T3300SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

docking station.

Though the T3300SL lacks a pointing device, nifty software, and extras that other vendors include, it does provide almost everything you need. These practical features are fit into one of the lightest, most compact, and sturdiest packages currently available. One of its best features is the 82-key keyboard, which is comfortable to use, and its generously spaced keys have an excellent travel distance. Much of Toshiba's competition may offer two of these three features, but very few have the complete trio. Also, the T3300SL is easily expandable with more memory or with other options like a 2,400-bps modem. Its only weakness might be the lack of simultaneous external VGA display. This laptop is not meant to be a presentation machine.

Its performance on our tests was competitive across the board. No performance scores dipped below the average. The battery lasted 3 hours 19 minutes without power conservation on our Battery Rundown test and an impressive 5 hours 8 minutes with its power-conservation features enabled on our ZDigit Rundown test.

Toshiba backs this machine with a one-year parts-and-labor warranty, toll-free technical support, and a support BBS as well. Repairs are left to the company's authorized service centers.—*OR*

FACT FILE

Toshiba T3300SL

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000.

List price (tested configuration): $2,798.

Tested configuration: 6MB DRAM, 64K external processor cache, 120MB Toshiba IDE hard disk with internal 32K buffer, 1.44MB floppy disk drive, Western Digital 90C23 chip set with 256K video DRAM, sidelit Toshiba STN LCD screen capable of 32 shades of gray, DOS 5.0.

Options: 2MB memory card, $299; 4MB memory card, $399; 6MB memory card, $599; 16MB memory card, $3,599; external keyboard, $159; numeric keypad, $79; battery charger, $289; extra battery, $199; universal ac adapter, $139; car battery adapter, $129; 2,400-bps MNP 5 modem, $454; external 1.2MB floppy disk drive, $399; SCSI adapter, $219.

In short: More than the sum of its parts, this practical, compact unit is a superb choice for those who really need to work on the road.

356 ON READER SERVICE CARD

Wyse Technology Inc.

DecisionMate 486SLC

Wyse Technology's $2,699 DecisionMate 486SLC successfully combines price and performance comparable with that of many 386SL notebooks in this review.

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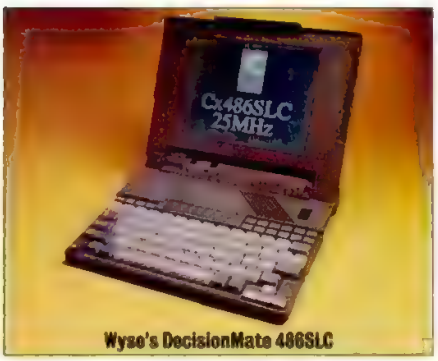
This Cyrix Cx486-SLC/25–based unit is small, measuring 1.8 by 11 by 8.9 inches and weighing 4.9 pounds with its nickel cadmium battery. The external floppy disk drive adds 1.3 pounds.



Wyse's DecisionMate 486SLC

The test unit came with 4MB of RAM (expandable to 8MB) a 127MB Quantum hard disk (a 200MB hard disk is available for $200 more), and Sharp backlit screen that measures 8.5 inches diagonally. Once you get the unit open, you can't help but notice the keyboard's large keys. The 10 function keys, however, are half-size and bunched into one corner. There are 4 dedicated cursor keys in an inverted T, with PgUp, PgDn, Home, and End embedded.

Of the four tested 486SLC/25s, the Wyse posted respectable test scores. Its memory score was especially high and fell in line with several of the Intel 486SX/25s and 486DX/25s. Its Graphics Winmark score was slightly below average.

On our Battery Rundown test, the Wyse lasted only 1.5 hours without power conservation; with power-conservation features enabled for our ZDigit Rundown test, it managed 2 hours 20 minutes. Because the battery needs 3 hours to charge with the unit off and the DecisionMate has only minimal power management, this is a potential problem. Wyse does offer an external battery, which it says will keep the portable going for another 3 hours.

SUITABILITY TO TASK

DecisionMate 486SLC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

DecisionMate 486SLC

Wyse Technology Inc., 3471 N. First St., San Jose, CA 95134; 800-438-9973, 408-473-1200; fax, 408-473-1972

List price (tested configuration): $2,699.

Tested configuration: 4MB RAM, Quantum 127MB hard disk, 1.44MB external floppy disk drive, DOS 5.0, Microsoft Windows 3.1, UltraFont, Resume, LapLink, InterLink/InterServer.

Options: 8MB RAM upgrade, $300; extra battery, $99; car battery adapter, $10; external battery, $149; 9,600/2,400-bps fax modem (send only), $199; 9,600/2,400-bps MNP 5 fax modem, $299; mouse, $79; trackball, $149.

In short: Wyse Technology's DecisionMate 486SLC is a respectable performer, but its short battery life is a disappointment.

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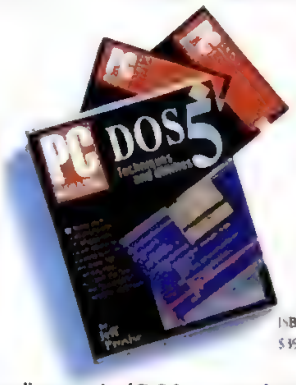

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The compact design makes you work a little to upgrade the machine. To add memory, the keyboard must be removed, and the battery pack is accessed by taking a coin to a screw, and a plug-in module is necessary to install a modem. Wyse offers a one-year parts-and-labor warranty, as well as 48-Hour Notebook Express. For the first year Wyse will pick up the portable, repair it, and deliver it via Federal Express at no charge.—*BG*

Zenith Data Systems

Z-Note 320Lb
Z-Note 320L
Z-Note 325L

Zenith's new line of portables are a little like classic statues of Greek gods: they're sleek, snow-white, and eerily perfect. Well, almost. We reviewed three of the Z-Note pantheons, including the $3,618 325L, the $2,768 320L, and the $2,368 320Lb.

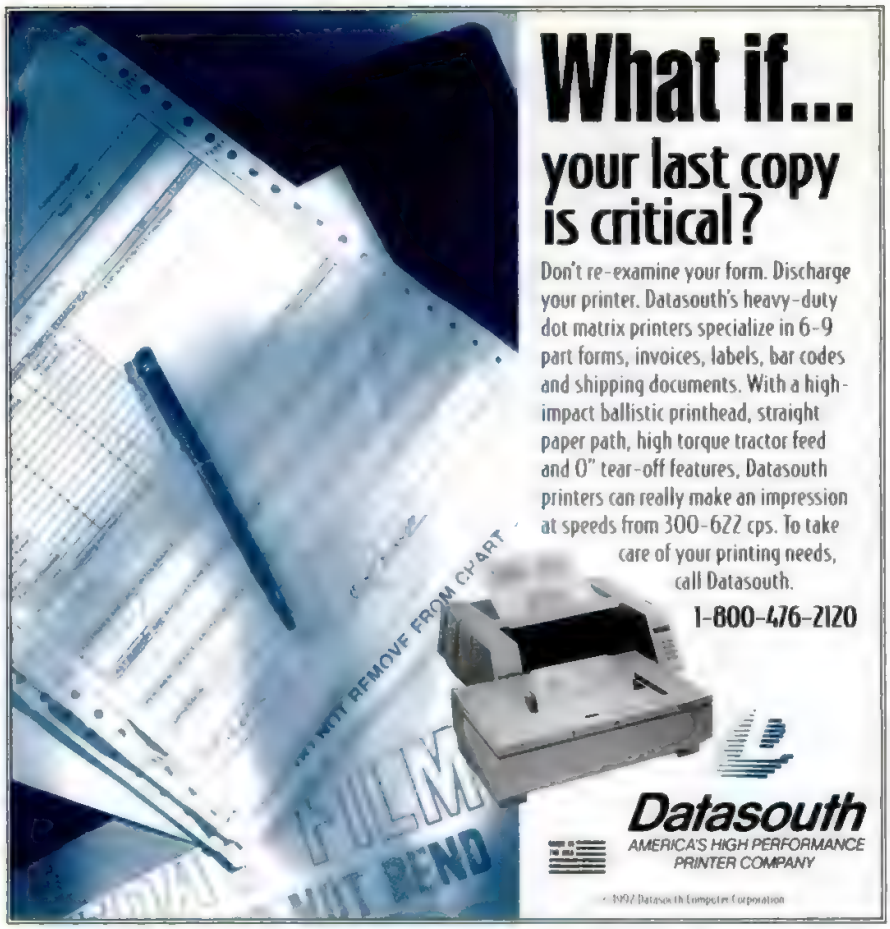
SUITABILITY TO TASK

Z-Note 320Lb	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Z-Note 320L	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	●
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Z-Note 325L	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The 2.2- by 11.8- by 8.5-inch, 6.6-pound Z-Notes have impressively designed cases that make for easy end-user upgrades. Installing more memory, a math coprocessor, or an internal modem



CIRCLE 171 ON READER SERVICE CARD

line is smooth and simple. ZDS sells user-installable color screens for these units that you can install if you tire of the monochrome display. Each machine includes parallel, serial, external VGA, and external keyboard ports, along with a PS/2-style mouse connector, all of which are located in the rear. If you need to use these systems on your desk and hate unplugging all of your peripherals, $109 will buy you a ReadyDesk port replicator, which has an easy on/off hook-up procedure.

The Z-Note 320L, the Z-Note 320Lb, and the Z-Note 325L

After opening the cases, however, you'll come across ZDS's Achilles' heel: its 82-key keyboard. Its stiff resistance and very small key travel make it difficult to type with. True, many of us use Windows for most of our work, and the Z-Notes do come with a Logitech Trackman Portable, but when the pointing and clicking is over and the serious work begins, you'll still be pounding your keyboard. Also, many of us are uncomfortable with any portable pointing device and so have learned to navigate Windows through keys rather than field mice. ZDS should have paid much closer attention to this important component.

Other central components include 2MB to 12MB of RAM (our test units had 4MB) and a 64K Intel-controlled external cache (for the 325L; the 320L and 320Lb had no external cache). Both the 320L and the 320Lb carried Conner 64MB IDE hard disks with internal 32K buffers, while the 325L contained a Conner 121MB IDE hard disk with a 64K internal buffer. All the Z-Notes had their video controlled by Cirrus chip sets with 256K of video DRAM. They are all capable of simultaneously running a Super VGA monitor in 16 colors on a simultaneous external monitor and VGAon their edgelit Sanyo LCD panels.

The Z-Notes' nickel hydride batteries weigh 1.24 pounds each, while the nicely sized AC adapters each weigh 1.7 pounds. Power-saving features are as advanced as the rest of this system, covering standby mode, hibernation mode, and hard disk and video time-outs. The Z-Notes have built-in network shells for NetWare, Microsoft LAN Manager, and VINES; just connect the optional media adapter and enter your password.

The 325L's performance was nothing short of stellar: Its scores were above-average to excellent across several of our benchmark tests. The more Spartan 320Lb's performance was disappointing; the unit scored the lowest in the 386SL/25 group in terms of its processor, memory, and DOSmark results.

ZDS covers these notebooks with a one-year parts-and-labor warranty. On-site service is available for the first year but costs extra.—*OR*

FACT FILE

Z-Note 320Lb

Z-Note 320L

Z-Note 325L

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60088; 800-533-0331, 708-808-5000; fax, 800-427-7211

List price (tested configuration): Z-Note 320L, $2,768, Z-Note 320Lb, $2,368, Z-Note 325L, $3,618

Tested configuration: 4MB 70-ns DRAM with 64K cache, Conner CP2124 121MB IDE hard disk with 64K buffer (Z-Note 325L); Conner 2064 64MB IDE hard disk with 32K buffer (320L and 320Lb). 1.44MB floppy disk drive, Cirrus Logic chip set, 256K video DRAM, edgelit Sanyo TSTN LCD, DOS 5.0, Microsoft Windows 3.1, 9,600/2,400-bps modem.

Options: 2MB RAM upgrade, $219; 8MB upgrade, $739; 120MB hard disk, $989, external keyboard, $99, numeric keypad, $69; extra battery, $159; battery charger, $129; 2,400-bps modem, $259; 9,600/2,400-bps fax modem, $369, port replicator, $109; thick or thin Ethernet adapter, $89, executive carrying case, $69, deluxe carrying case, $79

In short: Except for their keyboards (which we found disappointing), these sleek new arrivals from Zenith Data Systems herald a new assault on the long-time superiority of Toshiba's line of notebook PCs. They're definitely worth a look.

958 ON READER SERVICE CARD

Zenith Data Systems

Z-Sport 325S

If you're a fan of Zenith's Z-Note series but are looking for something smaller and less expensive, consider the $2,428 Z-Sport 325S, which attempts to resolve the conflicts between bulk and features.

Designed in the same sleek style as the Z-Notes, the 6-pound (with battery) Z-Sport measures 2 by 11 by 8.5 inches. While some system components are reminiscent of its Z-Note cousins, you can see where the company cut corners to keep the cost and size down.

The Z-Sport 325S

For example, the Z-Sport lacks the Z-Notes' integrated networking shells. If you want to connect with a Z-Sport, you'll have to go the route of buying either an external adapter or the $669 docking unit, which makes the keyboard awkward to use.

Though the Z-Sport's keyboard has four more keys than the Z-Notes do, it shares the same stiff resistance and short key travel. During our testing, the combination gave rise to too many typos to ig-

FACT FILE

Z-Sport 325S

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60088; 800-533-0331, 708-808-5000; fax, 800-427-7211.

List price (tested configuration): $2,428.

Tested configuration: 4MB DRAM, Conner 2084 845B IDE hard disk, 1.44MB floppy disk drive, Cirrus Logic chip set, 256K video DRAM, edgelit Matsushita TSTN LCD, DOS 5.0.

Options: 2MB RAM upgrade, $229; 120MB hard disk, $989; 387 math coprocessor, $329; external keyboard, $99; numeric keypad, $69; extra battery, $159; battery charger, $129; 2,400-bps modem, $259; 9,600/2,400-bps fax modem, $369; executive carrying case, $69; deluxe carrying case, $79; docking station (3 full slots, AT compatible), $669.

In short: Zenith Data System's low-cost Z-Sport may appeal to those on a tight budget, but we found its keyboard frustrating to use. That factor, combined with the Z-Sport's short battery life, make this entry tough to recommend.

559 ON READER SERVICE CARD

nore. The biggest complaint, however, is the tiny Enter, Shift, and Backspace keys. The keyboard is doubly unfortunate in view of the excellence of the remaining system components.

The 386SX/25 holds between 2MB and 8MB of RAM (our test unit arrived with 4MB) and an 84MB Conner CP IDE hard disk. There was no external cache, and the hard disk lacked a buffer as well. A Cirrus chip set controlled video with the aid of 256K video DRAM. The unit can display Super VGA in 16 colors externally; its edgelit 9.5-inch Matsushita TSTN LCD VGA panel can handle 64 shades of gray.

The Z-Sport's performance spanned the spectrum. It achieved a top memory score among the 386SX/25s and 386SL/25s but the lowest disk score.

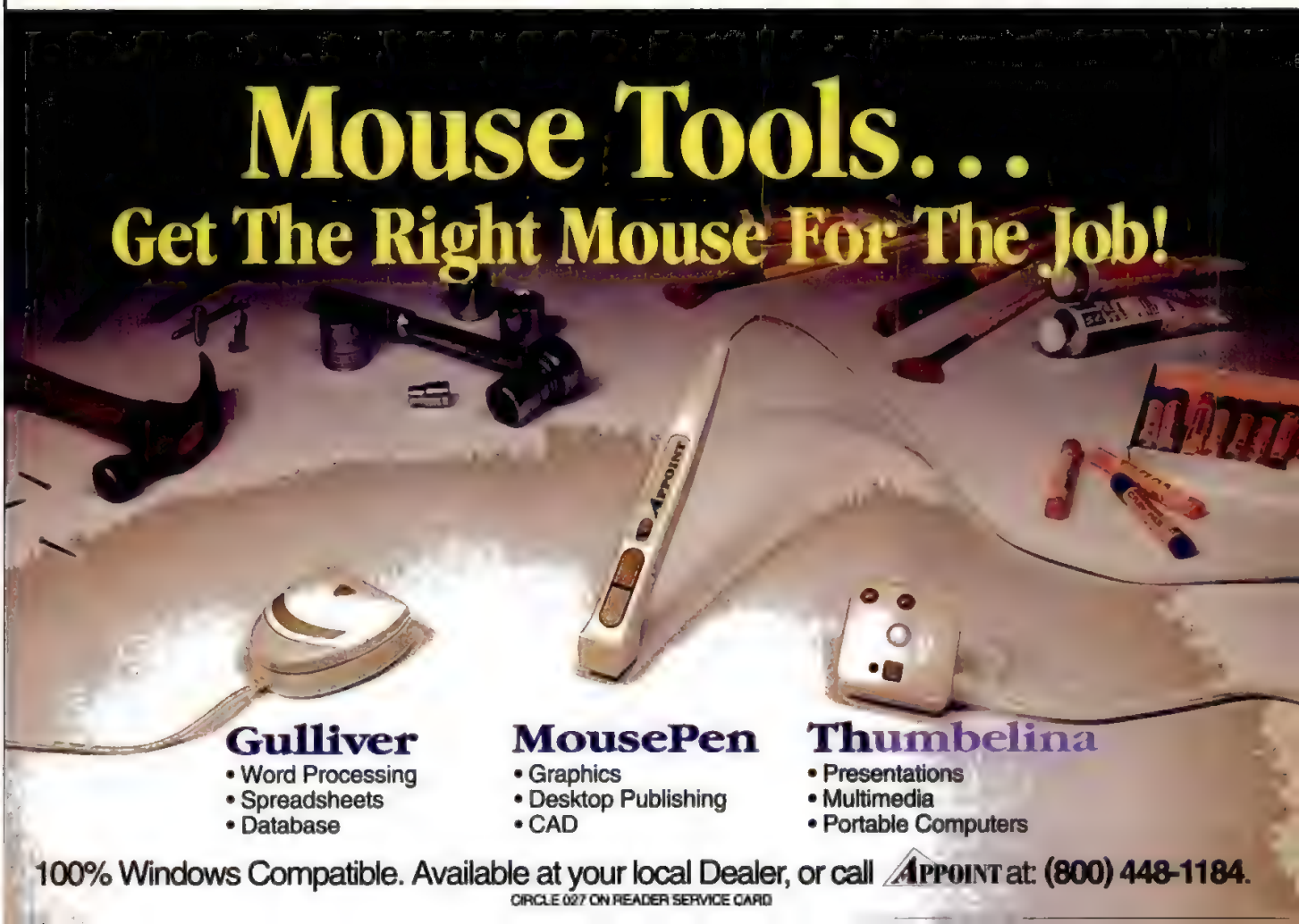
SUITABILITY TO TASK

Z-Sport 325S

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The Z-Sport's performance spanned the spectrum: It achieved a top memory score among the 386SX/25s and 386SL/25s but the lowest disk score. Other results were generally average. The nickel hydride battery lasted only 2 hours 3 minutes on our Battery Rundown test and 2 hours 47 minutes on our ZDigit Rundown test—hours behind some of its siblings' scores.

Warranty coverage is the same for all ZDS products: One year on parts and labor. On-site service is available for the first year but costs extra. —*OR* □



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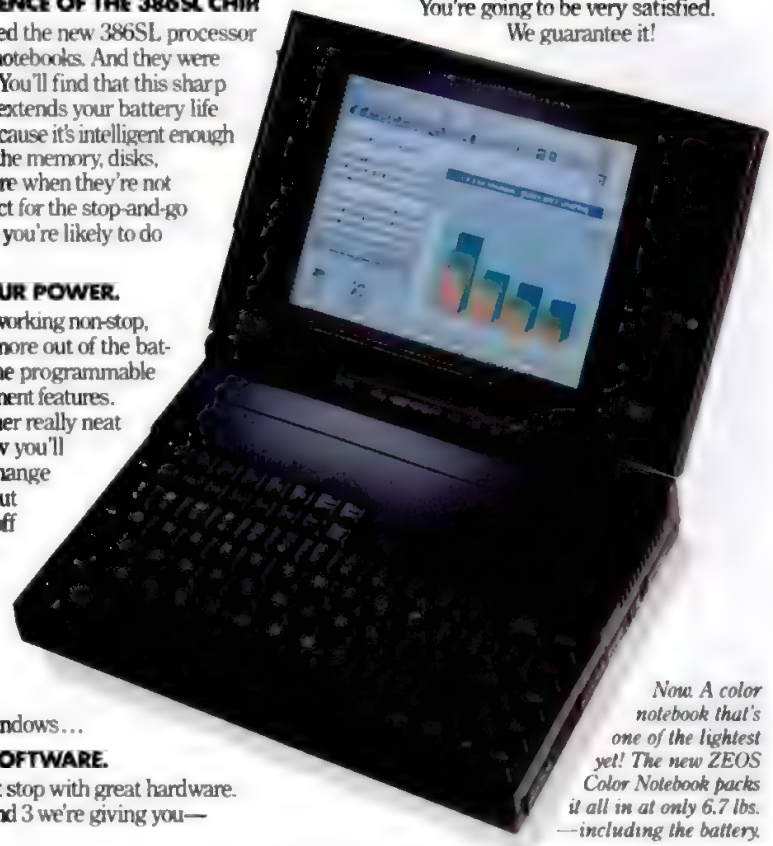

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COLOR NOTEBOOKS

Recasting Color In a New Light

The time has come to rethink the role of the color notebook PC. As prices of great color systems descend toward $3,000 (and prices of decent systems fall to around $2,000), all business users—not just the corporate elite—should seriously consider buying color portables exclusively.

IN THIS REVIEW

Compaq LTE Lite/25c *268*
Color Keynote 386SL-25 ..... *269*
Toshiba T4400SXC *279*
Z-Note 325Lc Model 120 ..... *290*
Zeos Color Notebook *291*
Performance Tests 281
Summary of Features 288

The advent of low-cost, high-quality screens has brought color portables within the reach of more and more business budgets. *PC Magazine* reviews the most recent additions to see how they stack up.

by Bill Howard

Photograph by Mark Weiss

HIGHLIGHTS

Color Notebooks

PRICE DECLINES have brought competent color portables within the reach of many business customers. What used to cost about $5,000 now goes for $3,000—a price that fits into many business budgets.

PASSIVE-MATRIX DISPLAYS continue to improve in terms of image quality and price, and machines with those displays are now competitive with some monochrome notebooks. Active-matrix display technology is still unbeaten, though.

IF YOU WANT a crisp, high-quality display with adequate contrast, the Toshiba unit remains without equal.

THE MORE COMPLEX COLOR display still translates into a thicker notebook with a shorter battery life than monochrome units with the same processor, but the differences are decreasing.

In this section, we examine five battery-powered color systems from Compaq, Keydata, Toshiba, Zenith, and Zeos. (Due to the familial heritage, the two Advanced Logic Research color units are reviewed with their monochrome brethren in that section and are listed on the monochrome Summary of Features table). The Toshiba T4400SXC, winner of a *PC Magazine* Award for Technical Excellence (that feature appears elsewhere in this issue), makes a return appearance from our August 1992 issue, where it won Editors' Choice. The rest are new, and at the vanguard of a revolution in color systems you're likely to see by early 1993.

CONVERTED TO COLOR

We're bullish on color portables for three reasons:

- Color allows the user to operate Microsoft Windows the way it was designed to be seen—in color, not some approximation based on gray scales.
- We have witnessed a decreased cost premium for color systems relative to monochrome.
- A new generation of passive-matrix color displays boasts improved quality at lower prices.

The great proliferation of color portables has been led by technical improvements in passive-matrix displays, although the image quality of the displays has in the past been disappointing. Previously, passive-matrix color added about $1,000 to the selling price of a comparable monochrome notebook PC; the much crisper active-matrix displays added about $2,000. Today, passive matrix commands a $500 price premium over monochrome, at most. At the same time, image quality is improving and screens are getting bigger—as large as 9.5 or 10 inches diagonal, instead of 8 or 8.5 inches.

And thanks to advances in active-matrix display technology, passive-matrix screens have been chasing a moving target. The joint venture between IBM and Toshiba, called Display Technology Inc. (DTI), is partially responsible for this improvement. The key has been faster display refresh rates, meaning the screen updates itself quickly and isn't subject to smearing when you move the mouse or scroll a page up or down. IBM and Toshiba have first crack at DTI displays, but you can expect to see them on other systems within a few months.

Notebook color systems do have some drawbacks, of course. The most notable are the slightly increased case thicknesses and shorter battery lives, both due to the more complex color display.

The Compaq LTE Lite/25c

REVIEW CRITERIA

Products included in this issue are battery-powered passive- or active-matrix notebook PCs that were shipping to customers as of late summer, and the Toshiba T4400SXC—an Editors' Choice award winner in *PC Magazine*'s August issue on portable computing. We tested the units over a three-week period in September, and prices are current as of late October.

Because color systems are necessarily a bit more bulky than monochrome units, we didn't set an upper weight limit. Even so, most fell within or not much over the 7-pound limit we set for monochrome PCs (not including extra batteries, power bricks, and accessories).

Many important color notebook systems were released just after our testing deadline. They include: AST Research's Power Exec 3/25SL; a 25-MHz 486-powered machine from Compaq; the IBM ThinkPad 700C; the PC Brand 486SLC Color LeaderBook; Texas Instruments' TI TravelMate 486SX/25 and TI TravelMate DX2/50; and the Toshiba Satellite T1850C. They'll be tested and reviewed in a future issue.

The reviews, test results, Price/Performance index, and Editors' Choice selection follow this introduction, as does the Summary of Features table. The chart illustrating battery life versus portability appears with that of monochrome notebook systems in the previous section.

Compaq Computer Corp.

Compaq LTE Lite/25c

The Compaq LTE Lite/25c uses the same Intel 386SL/25 processor as many of its competitors. But with a striking color screen and attention to details, it stands out. Its $4,025 list price (including modem) places it near the top in cost as well.

The 2.3- by 11- by 8.5-inch (HWD) case closes securely with catches on either side, and all ports except the modem connections are protected by sturdy hatches. The power switch is inside the case, and you can easily pop out the nickel hydride battery pack and slide in a replacement when you run low on power. The computer's 6.6-pound weight, and nearly 8 pounds with charger and case, are typical for its class.

About the only average feature of the

Compaq LTE Lite/25c is its performance; it did little to distinguish itself from other laptops with the same processor. The only results of note are strong showings on the Graphics Winmark test and DOS video test. The disk performance speeds were a little slow for its class, but it is unlikely that you'll notice the difference in actual operation.

On the Battery Rundown test without power conservation, the battery lasted 1.75 hours; but with power-conservation features enabled on the ZDigit Rundown test, the same machine ran nearly 4 hours. The system also is able to make full use of power-management features within Microsoft Windows. On a long flight, this computer will probably be ready to work more than you will.

SUITABILITY TO TASK

Compaq LTE Lite/25c

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

FACT FILE

Compaq LTE Lite/25c

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77069-2000; 800-345-1518, 713-370-0670

List price (tested configuration): $4,025

Tested configuration: 4MB RAM, 84MB hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 9,600-bps modem

Options: 2MB RAM upgrade, $264, 4MB RAM upgrade, $469, 8MB RAM upgrade, $846, 16MB RAM upgrade, $2,211; enhanced 2,400-bps internal modem, $279; enhanced 9,600-bps internal modem, $526; external keyboard, $174, external numeric keypad, $82 extra nickel hydride battery, $187; car battery adapter, $93, battery charger, $87, serial interface board, $109, docking station, $699. Docking station options: 120MB hard disk, $499, 210MB hard disk, $699, 1.2MB or 1.44MB floppy disk drive, $112, 60MB tape backup unit, $485, 80MB/120MB tape backup unit, $528

In short: The LTE Lite/25c is a color notebook that has a great display and long battery life with fair performance at a competitive price

583 ON READER SERVICE CARD

PC MAGAZINE

EDITORS' CHOICE

• Toshiba T4400SXC

Since *PC Magazine*'s August 1992 review of portables, many new color notebook computers have been announced. But only a handful—from Advanced Logic Research, Compaq, Keydata, Zeos, and Zenith—actually shipped in time for this issue's review. The best color notebook among the seven we review here (two ALR color units are reviewed with their sister systems in the monochrome laptop section) is from Toshiba America Information Systems: the Toshiba T4400SXC. That machine is also a winner of *PC Magazine*'s Award for Technical Excellence (that feature appears in this issue) and a previous Editors' Choice recipient.

For those who don't mind carrying almost 8 pounds, the Toshiba T4400SXC comes closest to a desktop machine among the portables we've seen. It combines a 25-MHz Intel 486SX processor, 120MB hard disk, and a bright 256-color Sharp 8.5-inch diagonal active-matrix LCD screen. Battery life is respectable for a color system at 2 hours 31 minutes. Communications options include high-speed modems and network adapters that fit into Toshiba's large proprietary slot.

ON THE HORIZON

What has been good will get better. Toshiba recently announced that the T4400SXC has been enhanced with a larger active-matrix display: a 9.5-inch diagonal unit from Display Technology Inc., Toshiba's joint venture with IBM. The unit also now boasts options, including an Intel 486DX/25 CPU and a 200MB hard drive. We expect that this Toshiba T4400C will be even better than our current Editors' Choice winner.

KUDOS TO COMPAQ

In addition, we give honorable mention to the Compaq LTE Lite/25c, which packs a lot of functionality for its size and weight (although at the expense of battery life). What the Compaq notebook lacks is a 486-class processor, which is rapidly becoming the minimum standard CPU for color portables.

The screen is the Compaq offering's most outstanding feature, with a deep black background and consistently bright colors. Compaq provides a Windows driver that supports 256 colors at VGA resolution. The unit can also show images on its LCD screen and an external screen at the same time, making it a good business partner for presentations.

Despite the unit's 11-inch breadth, the LTE Lite/25c has a good keyboard, with half-height arrow keys arranged in an inverted T. The keyboard's main weakness is that the half-height function keys and Pg Up, Pg Dn, Home, End, Insert, and Delete keys are crammed into a single row along the top.

There is an integrated trackball that does not quite satisfy: It's mounted on the right side of the screen with the "mouse" buttons behind it on the outside of the case, so the user must grasp the screen in order to use it. Our complaints do not even mention the complication this presents for lefties.

Compaq backs the system with toll-free technical support and a one-year parts-and-labor warranty with on-site service.—*Alfred Poor*

Keydata International Inc.

Color Keynote 386SL-25

The Color Keynote 386SL-25, from Keydata International, comes with an Intel 386SL/25 processor, a 120MB hard disk, 4MB of RAM, and a passive-matrix LCD

Suitability to Task: Color Notebooks

Color portables from Compaq Computer Corp. (the Compaq LTE Lite/25c) and Keydata International (the Color Keynote 386SL-25) were able to combine the light weight, long battery life, and communications devices that are required to make a portable PC a good travel companion. All the color portables we looked at received a *good* rating in the DOS applications category.

The Compaq LTE Lite/25c was judged to be an adequate desktop replacement, although with an important caveat: we found the Compaq's docking station to be bulky and uncomfortable to use. All the other machines received just a *fair* rating in this area.

Road warrior\communications estimates how complete a traveling companion each portable system will be. The optimal notebook combines in a small package light travel weight (no more than 9 pounds, including AC adapter and battery), long battery life (at least 3 hours on our ZDigit battery test with power-conservation features enabled), good communication options (such as a 9,600-bps data/fax modem or a PCMCIA card), and a 9-inch diagonal or larger color display

DOS applications measures each system's ability to run DOS software quickly. To rate *excellent* in this category, a system must have at least a 25-MHz 386 processor, as well as an 80MB hard disk or larger, a display that measures at least 8.5 inches diagonally, and a DOSmark score in the top 25 percent on PC Magazine Labs' Hardware Benchmark Tests, Release 7.0.

Windows applications are extremely demanding, requiring a combination of processor speed, high-volume data storage, and a high-quality video subsystem. To be worthy of a top rating in this area, a unit should have system memory that can be expanded to at least 8MB, a 120MB hard disk available, Graphics Winmark and Disk Winmark scores in the top 25 percent, a built-in pointing device, and power management that works under Windows. Image quality, such as the superior displays on the Compaq LTE Lite/25c and the Toshiba T4400SXC, was another criterion we looked at.

To be considered as a **desktop replacement**, a system had to be capable of internal expansion or have a docking station available, offer a 120MB hard disk or larger, and support Super VGA graphics on an external monitor. We also consider the portable's keyboard and whether an external keyboard can be plugged in.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

color screen. It also comes with an impressively low price of $2,795, which makes it the lowest-priced color notebook reviewed in this roundup. Unfortunately, it also has some shortcomings that counter the attractive price.

SUITABILITY TO TASK

Color Keynote 386SL-25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The dark gray case has a matte finish and the cover is held in place by two sturdy side catches. The case has hatches covering all ports except the power and external keyboard connectors, but the hatch for the expansion bus and video connectors is not hinged, which makes it easy to lose. The power switch is on the edge of the case where a right-handed user could turn it off inadvertently. The built-in trackball is very small and awkward to use.

The Color Keynote's biggest drawback, however, is its display. While it's fairly good for a passive-matrix LCD panel, it pales in comparison to the active-matrix designs in this test. It's dim, with anemic colors and blotchy areas of light and dark. Its highest internal resolution is 640 by 480 pixels, but the unit supports simultaneous display on an external monitor.

The Color Keynote 386SL-25

The machine's performance was about average for its CPU class, and it did well in its power-management tests. On PC Magazine Labs' Battery Rundown test without power conservation the machine lasted less than two hours; on the ZDigit Rundown test with power conservation it lasted more than four and a half hours. And this at a weight that is about par for its class.

The keyboard is also a bit better than average. The Esc and function keys are about three-quarter size, but the dedicated cursor arrow keys in an inverted T and the rest of the keys are full-size and conveniently arranged. The Backspace and Enter keys are also extra wide.

Keydata International offers customers toll-free technical support six days a week and a one-year parts-and-labor

FACT FILE

Color Keynote 386SL-25

Keydata International Inc., 111 Corporate Blvd., S. Plainfield, NJ 07080; 800-486-4800, 908-755-0350; fax, 908-756-7359

List price (tested configuration): $2,795.
Tested configuration: 4MB RAM, 120MB hard disk, 1.44MB floppy disk drive, DOS 5.0, Windows 3.1.
Options: 2MB RAM upgrade, $160, 4MB RAM upgrade, $240; 8MB RAM upgrade, $420; external 9,600/2,400-bps fax/data modem, $125; internal 9,600/2,400-bps fax/data modem, $165; external keyboard, $40; external numeric keypad, $60; extra nickel cadmium battery pack, $85; battery charger, $125; docking station, $270.
In short: Good price and perforamance is offset by a disappointing passive-matrix color display
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Our Contributors: BILL HOWARD is an executive editor of *PC Magazine*. ALFRED POOR is a contributing editor to *PC Magazine*.

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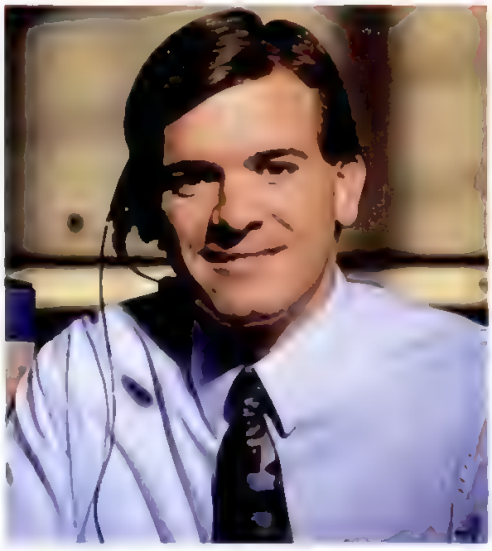

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- 85MB hard drive with MS-DOS 5.0, Microsoft Windows 3.1 and **Microsoft Windows for Workgroups** pre-installed
- Logitech™ TrackMan® Portable mouse
- 9.5" black-on-white LCD, upgradable to active matrix color, 640 x 480 VGA with support for 64 grey shades; and simultaneous video support
- 3.5" 1.44MB floppy drive
- 8.5" x 11.9" x 1.9," only 5.9 pounds
- Rapid-charge nickel metal-hydride battery for 4 hours* continuous use or up to 10 hours* under rest/resume condition
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- 82-key keyboard with 12 full-size function keys

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- 8.4" active matrix color VGA LCD, simultaneous video support
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Helen Lim,
ZDS Systems
Software Engineer
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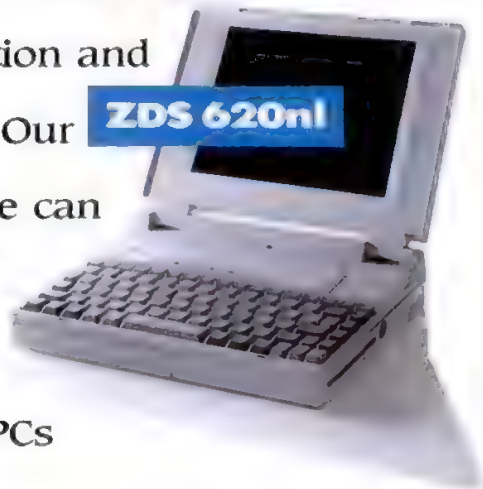

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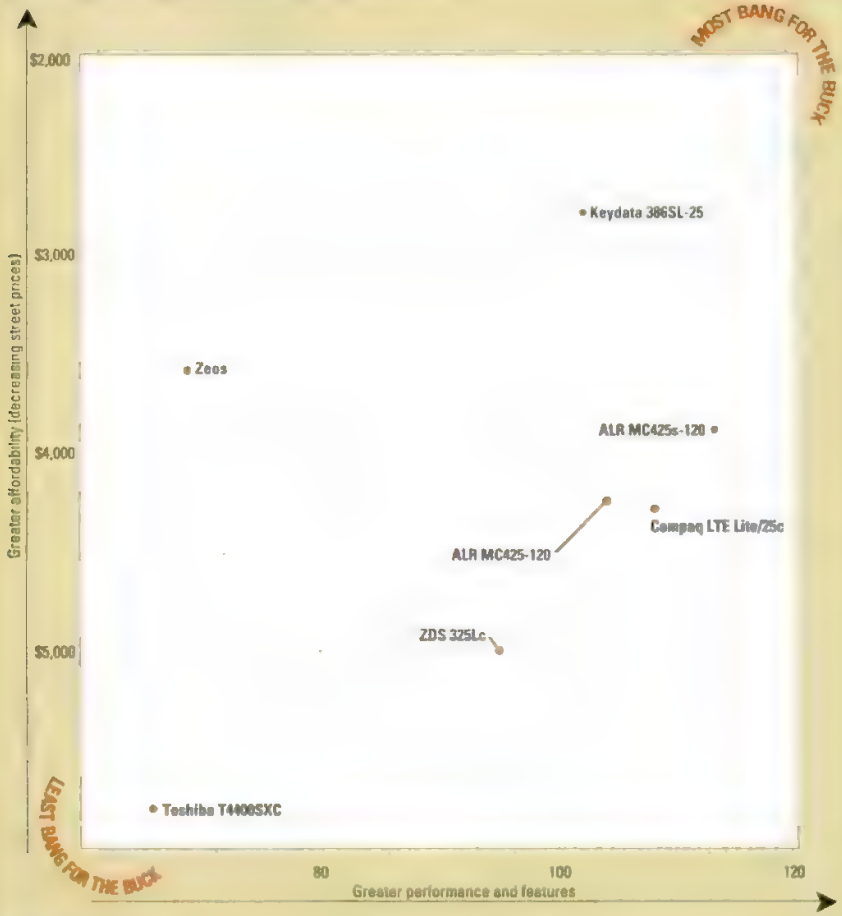
Price/Performance Index: *Color Notebook PCs*

Of the seven color notebooks included in our review, the best overall combined price/performance honors go to Keydata's Color Keynote 386SL-25. Priced at $2,795, it scored in the upper third of the performance and features scale, but relies on a passive-matrix display some might find disappointing. The ALR units, which racked up the most data points, fall in the $4,000 price range and also use passive-matrix displays. In the same price range and not far behind in overall performance is the Compaq, which offers the advantage of an active-matrix display. The 486-class Toshiba, while boasting an excellent active-matrix display and good scores on our benchmark tests, lost points because of its somewhat low hard disk capacity and disappointing ZDigit Rundown test performance.



THE DATA POINTS

This chart plots each system's selling price (*y*-axis) versus its performance index (*x*-axis). We discounted systems available only through dealers by 15 percent to approximate street prices.

The performance index is a composite score that takes into account our benchmark test results and numerous features. DOSmark, Graphics Winmark, and Disk Winmark scores account for 35 percent of the rating, system memory and hard disk size account for 16 percent, and the size, weight, and ZDigit Rundown test score (a measure of battery life) account for 11 percent each. The remaining 16 percent of the performance index is based on these features: display size, I/O ports, PCMCIA slots, internal modem, simultaneous external display capability, super VGA output, extra cursor keys, built-in pointing device, flash BIOS provision, ROM power-conservation features, 16550 UART support, enhanced parallel port, and hot-swap battery change capability.

To view the data we used to create this chart, look for 22BANG WK1 in the Software Library of PC MagNet's Editorial Forum.

warranty. Repairs are made by the vendor, so you'll have to ship the machine back if it needs work. The computer comes with DOS 5.0 and Microsoft Windows 3.1, plus your choice of Spinnaker's PFS:WindowsWorks, The Norton Desktop for Windows, GeoWorks Pro, Quattro Pro, or Sidekick.

Despite these extras and the long battery life, you may be better off with a good monochrome screen. If you really want color, spend the extra money for an active-matrix design.—*AP*

Toshiba America Information Systems Inc.

Toshiba T4400SXC

Last summer, Toshiba slashed prices on its notebook computers and the 120MB hard disk version of the Toshiba

The Toshiba T4400SXC

T4400SXC ended up with a list price of $6,098. For this price, you get a 256-color active-matrix LCD screen backed by an Intel 486SX/25 processor, 6MB of system RAM, and one of the best keyboards among notebooks.

The downside is weight: With battery

If you're willing to carry the extra pound or two, the Toshiba will reward your efforts with a crisp, bright display.

in place, the T4400SXC tips the scales at nearly 8 pounds—the total travel weight for most of its competitors. Add the power adapter, and you're close to 10 pounds total.

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Take our personal microLaser Plus for example. With its high duty cycle of 10,000 pages-per-month* and a standard one-year limited warranty**, you can rely on your microLaser to work the first time, every time, for years.

4. Value Starting as low as $999†, there's a microLaser designed to fit any budget. From the single user all the way up to a network. Consider this, too: microLaser's average cost per page is only 1.9 cents‡, while some laser printers average around 3.3 cents. The microLaser not only makes sense, it saves you money, too.

For details on the right microLaser for you and the name of the nearest dealer, call

1-800-527-3500.

The microLaser PS17 has earned the 1990 *PC World* Best Buy award; microLaser PS35 has earned the 1990 *InfoWorld* Excellent Value award and 4½ mice from *MacUser*, October 1990.

Features	microLaser Plus Basic	microLaser Plus PS17/PS35	microLaser Turbo	microLaser XL Turbo
PPM	9 ppm	9 ppm	9 ppm	16 ppm
Emulation	HP LaserJet II	HPLJII/PostScript	HPLJII/PostScript II	HPLJII/PostScript II
Processor	68000	68000	RISC/8220	RISC/8220
Fonts	14 HP Fonts	17 or 35 Scalable	35 Scalable	35 Scalable
List Price	$999	$1,399/$1,499	$1,749	$3,649

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*Based on estimated typical usage. **For more information on service upgrade options, call 1-800-847-5757 in the U.S. and 1-800-268-6314 in Canada. †Suggested retail price – dealer prices may vary. ‡Based on suggested retail price of consumables and approximate page coverage rating for each consumable at 4% black (toner, developer and OPC). microLaser is a trademark of Texas Instruments Incorporated. Microsoft and DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. LaserJet is a registered trademark of Hewlett-Packard, Inc. Apple and Macintosh are registered trademarks of Apple Computer, Inc. OS/2 is a registered trademark of International Business Machines Corporation. UNIX is a registered trademark of AT&T. ©1992 TI 76543

CIRCLE 353 ON READER SERVICE CARD

Benchmark Tests: Color Portables

The fastest color portables were those with 486 processors (including the two ALR color units, whose scores appear with those of their monochrome siblings). Portables with active-matrix color displays excelled in DOS video performance. Only the Toshiba T4400SXC combines both attributes.

HOW WE TESTED

As with the monochrome portables, we used PC Magazine Labs' new Hardware Benchmark Tests, Release 7.0, to predict PC processor, memory, video subsystem, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests, expressed in terms of throughput or operations per second. All of these results are summarized in a composite score called the DOSmark.

We also used the new Windows Benchmark Tests (Winbench), Release 3.1, to obtain the Graphics Winmark and Disk Winmark scores, which predict the relative performance levels using popular Windows applications

The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. It is derived from tests that use small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the presence or absence of a math coprocessor). The score indicates how well a computer's CPU and cache subsystems would execute common DOS and Windows applications.

The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory read and write tests, as well as 8- and 16-bit conventional-memory read and write tests. Taken together, these tests reflect the throughput of a computer's main memory.

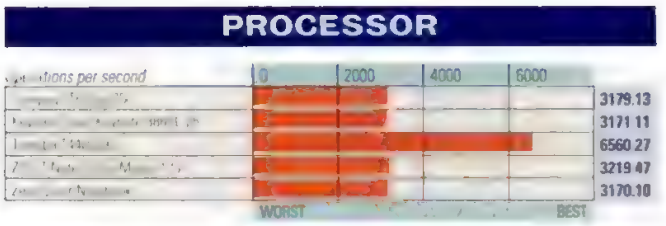
The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for a range of file sizes from 256K to 32MB. The tests are performed without software disk caches installed

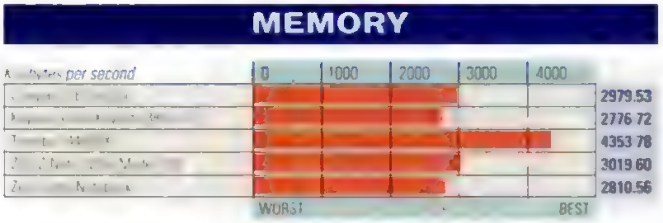
The **video** score is based on direct-to-screen text-write and graphics-write tests. Taken together, these tests reflect the video throughput for a standard EGA/VGA adapter running DOS applications.

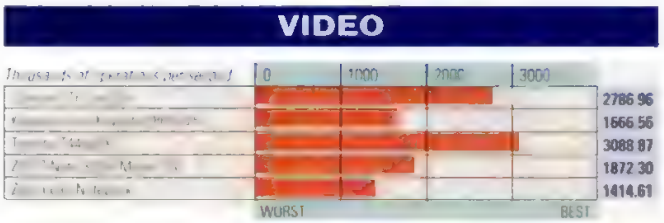
The **DOSmark** score is a composite rating derived from the processor, memory, video, and disk test scores. The DOSmark indicates a computer system's ability to run DOS applications.

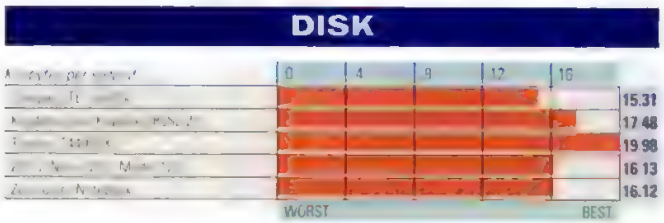
The **Graphics Winmark** score is based on 12 Windows graphics and text functions derived from extensive profiling of popular Windows applications. It is measured in megapixels per second (a megapixel is 1,048,576 pixels).

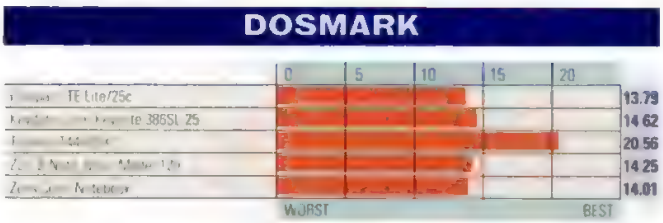
The **Disk Winmark** score is based on testing techniques adapted from the DOS disk tests to reflect operations within the Windows environment. For this portion of the testing, the systems were configured with up to 2MB of SmartDrive cache

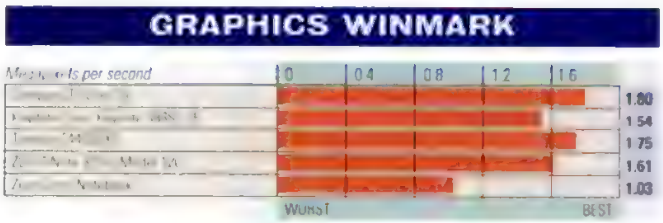


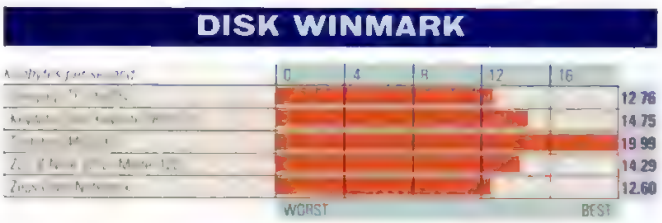












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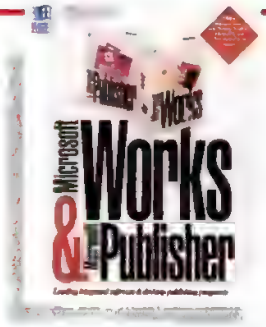

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8101 ▣NewWave 4.0 ..... 109.
IBM
2666 ☐DOS 5.0 Upgrade ..... 59.
7303 ☐OS/2 2.0 Upgrade from DOS ..... 99.
Inset Systems
7298 ▣HiJaak 2.1 139. 3820 ▣for Windows 139.
7300 ▣Inset Plus HiJaak ..... 165.
Intuit
2426 ▣Quicken 5.0 45. 5596 ▣for Windows . 45.
6158 ▣QuickBooks 1.0 ..... 89.
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6882 ▣PrintCache 3.0 ..... 99.
9510 ▣PrimeType 1.0 for WordPerfect ..... 62.
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7415 ☐Ofoto 1.0 for Windows ..... 269.
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5417 ☐1-2-3 3.1 Plus ..... 399.
5653 ☐1-2-3 2.4 ..... 335.
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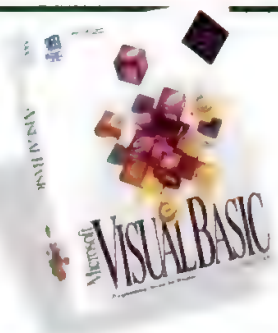
2755 ☐1-2-3 1.1 for Windows ..... 335.
3424 ☐1-2-3 1.1 for Windows Upgrade ..... 99.



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1620 ☐MS-DOS 5 Upgrade ..... 59.
6188 ☐FoxPro 2.0 ..... 479.
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8659 ▣Cursor Deluxe 1.0 ..... 27.
Nolo Press
2982 ▣WillMaker 4.0 ..... 35.
Norton-Lambert
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8564 ☐Smart Investor 1.0 ..... 59.
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7483 ▣Grammatik V for Windows ..... 55.
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3784 ☐The Norton Backup 2.0 for Windows ... 99.
3146 ☐The Norton Utilities 6.0 ..... 115.
7999 ☐Norton Anti-Virus 2.0 ..... 84.
2359 ☐The Norton Desktop 2.0 for Windows 115.
8378 ☐Norton PC Anywhere 4.5 ..... 119.
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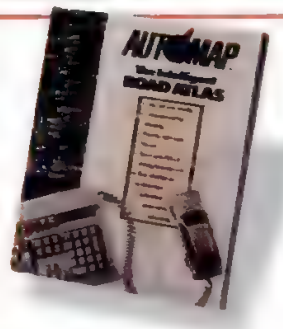
4411 ▣SimEarth 1.0 for Windows from Maxis 45.
Davidson & Associates
3947 ▣Math Blaster Plus ..... 29.



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4692 ▣Dvorak on Typing for Windows..... 29.
4684 ▣Dvorak Top 30 *(30 best shareware)*.... 35.
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6456 ☐Isaac Asimov's Science Adventure ..... 49.
3510 ☐Space Adventure ..... 49.
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5095 ☐Teen. Mutant Ninja - Manhattan Mission 29.
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4833 ▣Super Tetris 1.0 for Windows ..... 29.
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8444 ☐Carriers at War..... 39.
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5143 ▣Go Master Deluxe 5.0..... 99.
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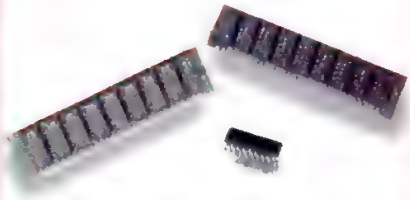
1162 ▣Mickey & Friends Fun Pack 1.0..... 23.
2629 ▣Mickey's 123's or 2624 ABC's..... *ea.* 29.
9984 ▣The Animation Studio 1.0 ..... 72.



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8993 PM2400 Modem *(internal, V.42bis)* ..... 115.
8994 PM2400 Modem *(external, V.42bis)* ..... 125.
8132 PM2400 Pocket Modem ..... 109.
2266 PM9600 Internal Modem ..... 275.
7934 PM9600SA Modem ..... 289.
2264 PM2400FX96 *(internal modem/fax)* ..... 95.
1344 PM2400FX96SA *(external modem/fax)*.. 99.
3803 PM14400FX96 *(internal modem/fax)* ... 359.
2425 PM14400FXSA *(external modem/fax)*.. 399.

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4804 Pocket Fax Windows ..... 189.
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Standard Microsystems ... 5 years
6376 Ethercard Plus Elite 16 or 6370 16T *ea.* 139.

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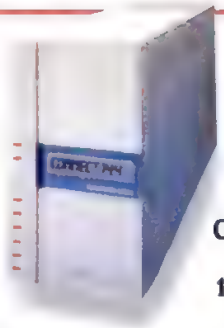

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9312 BC500 Power Backup ..... 219.
6506 BC1250 LAN Power Backup ..... 499.
6018 LC1200 *(line conditioner)* ..... 159.
1528 PS6.0 *(600VA online UPS)* ..... 559.
Zoom Telephonics ... 7 years
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1178 Ext. 2400 Baud w/9600 Baud Fax Modem 92.
1494 Ext. 9600V.32bis... 195. 3075 Int. ... 195.
3574 Ext. 2400 Baud V.42/9600 Baud Fax... 115.
3386 FaxModem AFC *(2400 baud 96S/48R)*.. 59.
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6343 PC Powered 90 *(incl. PC2B & cart.)*..... 499.
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2500 PC2B-2 Controller ..... 149.
2530 90 MB Cartridge.. 149. 2467 Tripak .. 439.
8480 Tape250 Insider Tape Backup ..... 239.
8481 Tape250 Inside Half-Height Tape Bckp 259.
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6581 CDR84 for PC/XT/AT ..... 499.
7023 MPC Upgrade Kit *(with CDR37)*..... 949.
7021 MPC Upgrade Kit *(with CDR84)*..... 1079.
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2761 1.44EX MB Ext. *(for any parallel port)*.. 239.

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4414 3½"/5¼" Dual Floppy Drive ..... 145.

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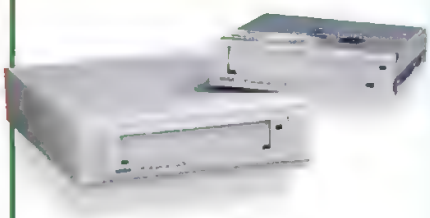
6343 *PC Powered 90*—Lowest priced Bernoulli drive ever in one complete, convenient package. Includes 90 MB cartridge, PC2B interface card, and cable..... **$499.**
6344 *PC Powered 90 PRO* ..... **599.**



IOMEGA ... 1 year
Tape250—QIC & Irwin compatibility in one affordable tape drive! Stores 250M & includes data compression & *Central Point Backup*.
8480 *Tape250 Insider Tape Backup* ..... **$239.**
8481 *Insider HH* **259.** 8482 *PC Powered* **359.**

DISKS/MEDIA

Fuji ... lifetime
2214 3½" DS Disks*(10)*.... 9. 2242 *(50)*..... 32.
2215 3½" HD Disks*(10)*.. 15. 2241 *(50)*..... 59.
2239 3½" HD Color Disks *(Qty. 10)*..... 16.
2243 3½" DS Color Disks *(Qty. 10)*..... 10.
Sony ... lifetime
3292 5¼" HD Disks*(Qty. 10)* ..... 11.
3297 3½" DS Disks *(10)*..... 9. 6148 *(30)*.. 25.
3298 3½" HD Disks *(10)*... 15. 6375 *(30)*.. 42.
8185 QD2040..... 14. 1895 QD2120..... 21.
3M ... lifetime
3943 DC2000..... 17. 1581 DC2120..... 23.

Toshiba ... 2 years
4858 3½" 2.88 MB ED Disks *(Qty. 5)*..... $28.
9755 3½" 2.88 MB ED Disks *(Qty. 10)*..... 53.

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Zoom Telephonics ... 7 years
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3075 *Internal 9600 V.32bis Modem*..... **195.**

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▶ SUMMARY OF FEATURES

Color Portable PCs

Products listed in alphabetical order

■ = YES □ = NO

	Compaq LTE Lite/25c	Keydata Color Keynote 386SL-25	Toshiba T4400SXC (PC Editors' Choice)	ZDS Z-Note 325Lc Model 120	Zeos Color Notebook
List price (*PC Magazine* configuration)	$4,025	$2,795	$6,098	$5,368	$3,590
Processor type and speed	Intel 386SL/25	Intel 386SL/25	Intel 486SX/25	Intel 386SL/25	Intel 386SL/25
Microsoft Windows 3.1	■	■	□	■	■
Hard disk capacity	84MB	120MB	120MB	122MB	130MB
Dealers/direct-distribution channel	■□	■■	■□	■■	■■
Dimensions (HWD, in inches)	2.3 x 11 x 8.5	1.9 x 11.8 x 8.3	2 x 11.5 x 8	2.2 x 11.8 x 8.5	2.3 x 11.6 x 8.3
Weight/travel weight (pounds)	6.6, 7.9	6.8, 7.8	7.9, 9 7	6.5, 8	6.5, 7.9
Display area (H x W, in inches)	5.3 x 6 8	5.3 x 7	5.5 x 7	5.3 x 6.8	5.4 x 7.3
Keys: total, function, cursor	80, 10, 4	84, 10, 8	82, 12, 8	84, 12, 8	85, 12, 8
Motherboard					
Motherboard manufacturer	Compaq	Chicony	Toshiba	ZDS	Zeos
Chip set manufacturer	Compaq	Intel	Intel	Intel	Intel
BIOS version (or date)	Compaq (5/8/92)	System Soft (1/1/92)	Toshiba (4/14/92)	ZDS (7/14/92)	Quadtel/System Soft (6/19/92)
Setup in ROM/Password in ROM	■■	■■	■■	■■	■□
System shadowing/Video shadowing	■■	■■	■□	□■	■■
Memory and Disk Drives					
Installable RAM	4MB–20MB	2MB–8MB	4MB–20MB	2MB–12MB	2MB–20MB
User-installable	□	■	■	■	■
External processor RAM cache	64K	64K	8K	64K	64K
Available hard disk sizes	84MB, 120MB	80MB, 120MB	80MB, 120MB	60MB, 85MB, 120MB	60MB, 130MB, 180MB
I/O and Expansion					
Parallel, serial, mouse ports	1, 1, 1	1, 2, 0	1, 1, 1	1, 1, 1	1, 1, 0
Proprietary expansion port	■	■	■	□	□
PCMCIA slot	□	□	□	□	□
Expansion unit	$699	$270	$849	$109	□
Internal modem options	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax	2,400-bps/ 9,600-bps MNP 5 send/receive fax
Video					
Screen manufacturer	Compaq	Sanyo	Toshiba	Sharp	Sharp
Type of display	Active-matrix	Passive-matrix	Active-matrix	Active-matrix	Passive-matrix
Maximum simultaneous colors	256	256	256	16	16
Video chip set manufacturer	Compaq	Cirrus	WD	Cirrus	Cirrus
Simultaneous external display	■	■	■	■	■
Maximum external resolution	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600
Maximum external colors	256	16	256	16	16
AC Adapter and Battery					
AC adapter size (inches)	1.5 x 5.3 x 3.3	0 8 x 6 x 3	2 x 6 x 3	1.5 x 6 x 2.8	1.8 x 5.5 x 2.8
Rated battery life (hours)	4	2	3	2.3	2
ZDigit, battery rundowns (hr.min)	3.57, 1 45	4 39, 1.58	3.58, 2 31	2.33, 1·51	N/A, 1.35
Charge time while on, off (hours)	1.5, 1	2, 2	4, 1.5	N/A, 3	5, 1.5
Battery weight, amp/hour rating	1 3 lbs , 2.5Ah	1 lb , 2 4Ah	2.3 lbs , 1 9Ah	1 2 lbs , 1 3Ah	1.1 lbs., 2Ah
Display/hard disk power-down	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	■■	■□	■■	■■
Standby/Hibernation	■■	■■	■■	■■	■□

N/A—Not applicable The product does not have this feature
WD—Western Digital Corp

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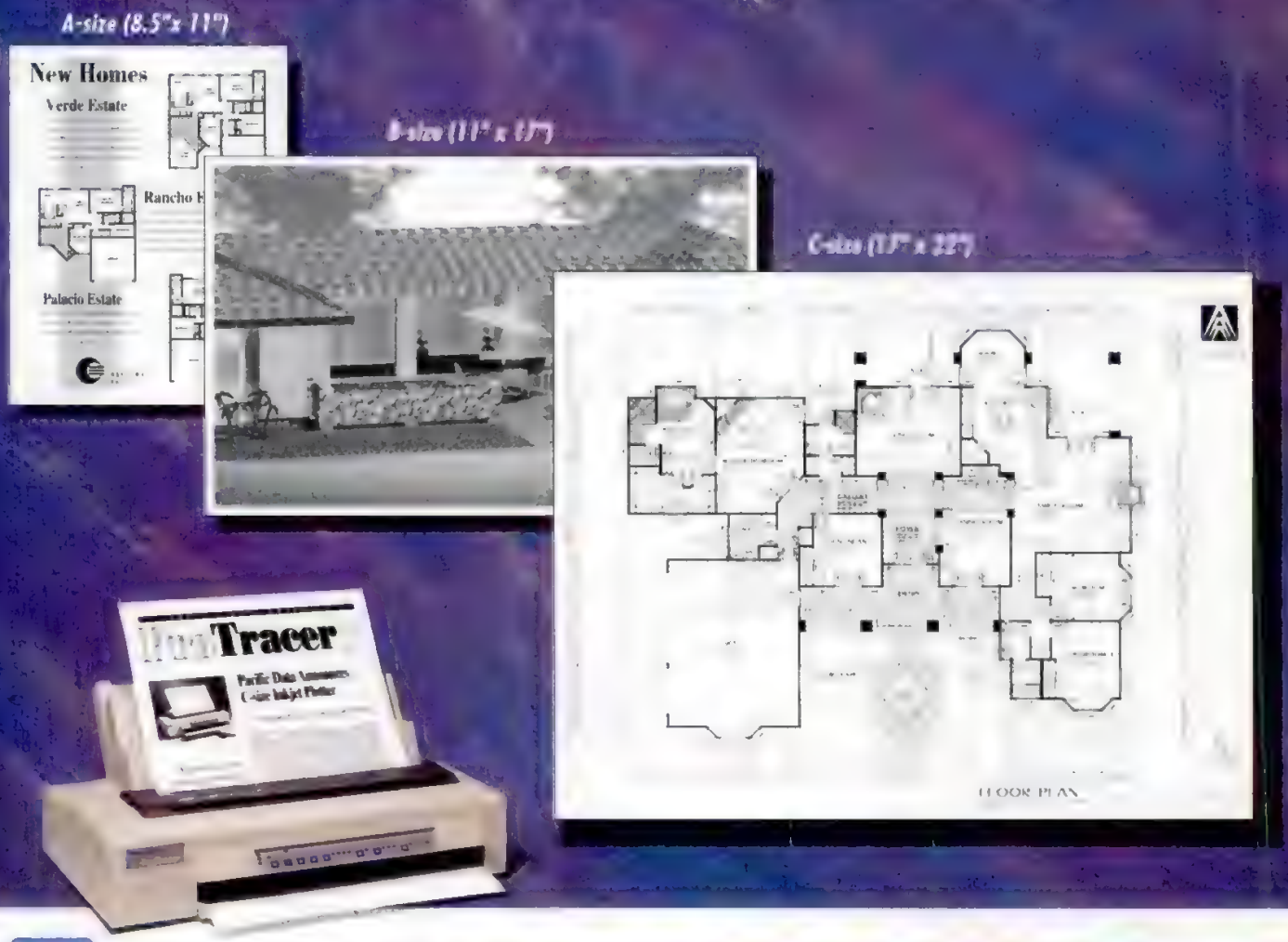

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SUITABILITY TO TASK

Toshiba T4400SXC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

pound or two, the T4400SXC will reward your efforts with a crisp and bright active-matrix LCD capable of 256-color VGA-resolution under Windows. The only flaw was a slight tendency for ghosting on horizontal lines. Not only is the display attractive, it was the fastest machine of all in our DOS video test.

The T4400SXC lasted an impressive 2.5 hours on the Battery Rundown test, thanks in part to its 1.9Ah (Amp hours) nickel cadmium battery pack (which accounts for more than two pounds of the computer's weight.) Extensive power-management features extended the run time to nearly 4 hours under the ZDigit Battery Rundown test—the second-best time of all 486SX/25 machines, either color or black and white.

Another strong feature is its keyboard, although it is at the price of an 11.7-inch wide case. The Esc and function keys are half size and arranged along the top row, but all the other keys are standard size. The arrow keys are in an inverted T at the bottom right, with the other cursor movement keys conveniently in a column along the right edge. Both the Backspace and Enter keys are oversized.

All ports except the power input are covered by hatches, though not all are attached with hinges. The video port provides simultaneous display at 640-by-480 resolution. Toll-free technical support is available and the computer comes with a one-year warranty.—*AP*

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Toshiba T4400SXC

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000.

List price (tested configuration): $6,098.
Tested configuration: 6MB RAM, 120MB hard disk, 1.44MB floppy disk drive, DOS 5.0.
Options: Intel 486DX upgrade, $699; 2MB RAM upgrade, $299, 4MB RAM upgrade, $399, 8MB RAM upgrade, $799, 16MB RAM upgrade, $3,599; 2,400-bps fax modem, $329, 2,400-bps V.42bis MNP 5 modem, $259; 2,400 bps V.22bis modem $199; external keyboard adapter, $159; external numeric keypad, $79; extra battery, $345, car battery adapter, $139.95; battery charger, $289, external floppy disk drive, $399, docking station, $849
In short: If you're looking for a quality computer with a good color screen, the Toshiba T4400SXC (though a little heavy) is worth consideration.
585 ON READER SERVICE CARD

Zenith Data Systems

Z-Note 325Lc Model 120

The $5,368 Z-Note 325Lc Model 120, from Zenith Data Systems, packs much into its 6.5 pound package. It boasts a 120MB hard disk, 4MB of RAM, a brilliant active-matrix color screen, an Intel 386SL/25 CPU, plus one other feature that no competing color notebook has: an Ethernet-compatible network interface. Our test model also included an optional 9,600/2,400 fax modem.

The Z-Note 325Lc Model 120

Even with the AC adapter, the travel weight is 8 pounds, which is typical for machines in this class. The case has a hinged cover for the I/O ports, and there is even a steel security ring that you can use to lock down your notebook.

The power switch is inside the case and there is an LCD window which displays icons to indicate which devices are active. The machine has various power-management features, including a rest mode that allows you to resume where you left off. This can be triggered simply by closing the case. In spite of these features, the Z-Note's performance on our battery tests was not up to par. It managed nearly 2 hours in the Battery Rundown test without power-conservation features enabled, but only 2.5 hours in the ZDigit Rundown test with power management activated. Other test scores were slightly above average, with a particular bright spot being its processor performance, where it was only bested by its Z-Note 325L sibling.

The active-matrix screen is one of its greatest strengths, though it can only produce 16 colors in 640-by-480 resolution. The image is bright and crisp, with no hints of ghosting. The keyboard is also excellent: standard-size or larger keys, an inverted T for the arrow keys, two Ctrl and two Alt keys, and oversized Enter and Backspace keys. The only design drawback is the included Logitech TrackMan Portable trackball. This hooks to the side of the computer but can hinder access to the floppy disk drive.

If you work on a network, the Z-Note has built-in Ethernet support and comes ready to go with software shells for Banyan's VINES, Microsoft LAN Manager, and Novell NetWare. You can also get

SUITABILITY TO TASK

Z-Note 325Lc Model 120

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Z-Note 325Lc Model 120

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60088; 800-553-0331, 708-808-5000; fax, 800-427-7211

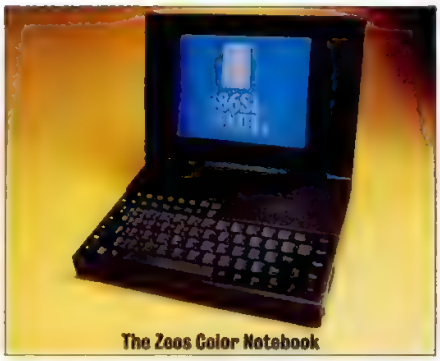
List price (tested configuration): $5,368
Tested configuration: 4MB RAM, 120MB hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 2,400/9,600-bps fax modem.
Options: 2MB RAM upgrade, $219; 8MB RAM upgrade, $739; 2,400-bps modem, $259, 9,600/2,400-bps fax/data modem, $369, external keyboard, $99, external numeric keypad, $69, extra battery, $159; battery charger, $129; port replicator, $109, thick or thin Ethernet adapter, $89; on-site service, $158.
In short: If you're interested in a color notebook which comes network-ready, look no further.
586 ON READER SERVICE CARD

a $109 port replicator which makes it easy to connect to desktop cables without the expense of a full-blown docking station. Zenith offers toll-free technical support five days a week. There is also a one-year warranty, with an optional on-site service contract available for $158.—*AP*

Zeos International Ltd.

Zeos Color Notebook

The Zeos Color Notebook, from Zeos International Ltd., has one of the lowest list prices of any color notebook in this review: $3,590. This is no stripped-down model either, as it includes a 130MB hard disk, 4MB of RAM, a 1.44MB floppy disk drive, internal fax modem, DOS, Microsoft Windows, and two Windows applications, all driven by an Intel 386SL/25 processor with a 64KB system cache. While this is a good price for a complete system, the trade-off is the poor quality of the passive-matrix display.


The Zeos Color Notebook

The notebook weighs 6.5 pounds and just under 8 pounds with the AC power adapter. All ports (except for the power input) are covered by a hinged door. The power switch is located on the outside of the case, but is designed in a way that should reduce accidental power-ons.

The Zeos Color Notebook did not stand out in PC Magazine Labs' benchmark tests; a few scores were on the slow side of average. The Battery Rundown time (without power conservation) was one of the shortest for a color machine: just 1.5 hours.

The color LCD screen compares favorably to other passive-matrix displays we've seen, but pales in comparison to active-matrix designs currently on the market. It's not as bright or clear, and suffers from blotches of inconsistent contrast across the screen.

On the other hand, the keyboard on the Zeos Color Notebook is better than average. All keys are full-sized, except the Esc and function keys. The inverted-T arrangement for the arrow keys and the other cursor keys along the right edge makes for an easy adjustment to the different layout.

SUITABILITY TO TASK

Zeos Color Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/ communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The computer comes with DOS 5.0 and Microsoft Windows 3.1 and your choice of two of three offered Lotus Development Corp. application programs: 1-2-3 for Windows, Ami Pro, and Freelance Graphics for Windows. You also get an internal fax modem in the bargain.

Zeos offers a 30-day money-back guarantee, 24-hour toll-free technical support, and a one-year parts-and-labor warranty. For an additional $49, factory repairs will be completed in 24 hours.—*AP* □

FACT FILE

Zeos Color Notebook

Zeos International Ltd., 530 5th Avenue NW, St. Paul, MN 55112; 800-423-5891, 612-633-4591; fax, 612-633-1325

List price (tested configuration): $3,590

Tested configuration: 4MB RAM, 130MB hard drive, 1.44MB floppy drive, DOS 5.0, Microsoft Windows 3.1, two of three Lotus applications (1-2-3 for Windows, Ami Pro, Freelance Graphics for Windows) mouse, 2,400/9,600-bps send/receive fax modem.

Options: 4MB RAM upgrade, $330, 8MB RAM upgrade, $580, 16MB RAM upgrade, $1,030; external 1.2MB floppy disk drive, $279; external keyboard, $69.95, numeric keypad, $79, Logitech TrackMan Portable mouse, $40, external VGA color monitor, $399, extra battery, $89, car battery adapter, $149; Ethernet adapter, $349, math coprocessor, $99; leather carrying case, $100

In short: If the screen display is acceptable to you, then the Zeos represents an attractive value

587 ON READER SERVICE CARD

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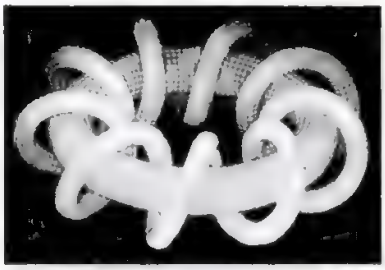
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CIRCLE 086 ON READER SERVICE CARD

CD-ROM DRIVES

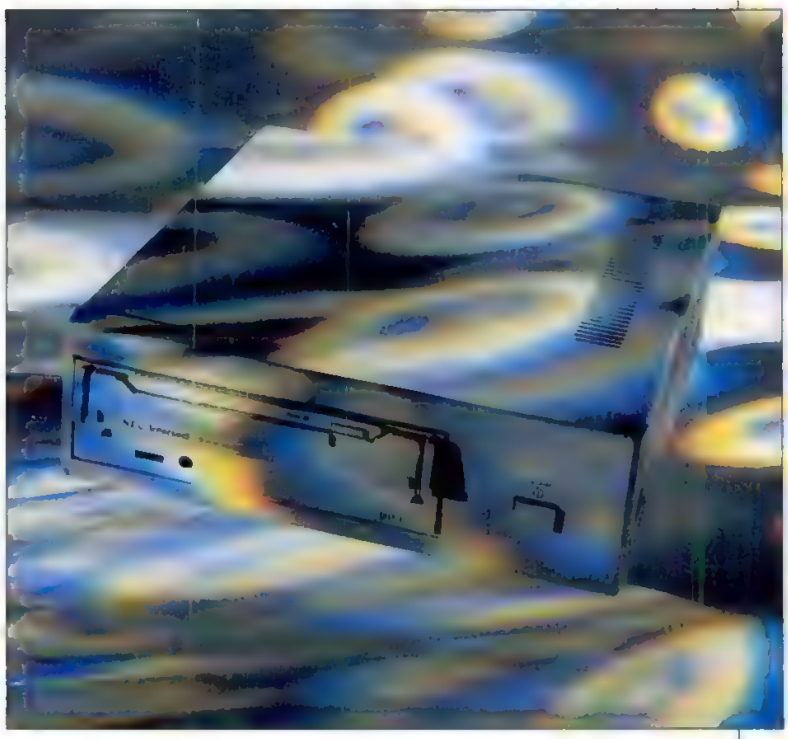
Mass Appeal

They're not the fastest storage devices on the block and they're not rewritable, but nothing beats CD-ROM (compact disk read-only memory) as an inexpensive medium for the mass distribution of information. With mail-order houses offering internal CD-ROM drives for as little as $200, and with publishers able to store up to 630MB of data on a single 4.72-inch disk—not to mention the increasing interest in multimedia—CD-ROMs are gaining wide appeal.

The disks can cost as little as $1.50 to produce, and the growing installed base of CD-ROM drives—market analyst Dataquest expects 1.5 million units to be

IN THIS REVIEW

CD Porta-Drive Model T3301 308
Chinon CDC-435 310
Hitachi CDR-3700 312
Hitachi CDR-3750 312
LMS CM225 316
Liberty 115 Series CD-ROM 317
MacProducts Magic CDR74 325
MacProducts Magic 3301 Toshiba 325
NEC InterSect CDR-37 328
NEC InterSect CDR-74 328
Philips CM-205XRS 330
PLI CD-ROM Drive 330
Procom PXCDL 332
Procom SXCDS-C8 332
Sony CDU-31A-02 333
Sony CDU-7211 333
Storage Devices SCD-683 337
Tandy CDR-1100 338
Texel DM-5024 340
Todd TCDR 7000 343
Todd TCDR 7050 343
Performance Tests 310
Summary of Features 334



CD-ROM drives are one of the best ways to provide access to large amounts of information. Transfer rates are up and prices are down. Here, you'll find some drives that list for just over $300.

by John R. Quain

Photograph by Jeffrey Krein

shipped worldwide in 1992—has led companies such as Corel Systems to distribute large applications like CorelDRAW on CD-ROM. Desktop publishers no longer have to fill up expensive hard disk real estate with rarely used clip art, choosing instead to leave big bitmaps on the CD-ROM disk to be called up as needed.

REVIEW CRITERIA

For this review, *PC Magazine* requested external, single-disk CD-ROM players (industry sources we spoke with agree that external drives are currently more popular than internal models). If the company did not offer external versions at test time, however, internal units were accepted. The CD-ROM players had to be DOS-compatible, and they had to meet the Multimedia PC (MPC) Marketing Council's sustained data transfer requirement of 150 kilobytes per second (KBps), using a SCSI (small computer system interface) or proprietary host adapter. We also accepted DOS-compatible portable designs that relied on parallel-to-SCSI interfaces.

As PC Labs' test results clearly show, CD-ROM drives aren't going to outpace hard disks anytime soon. But they are getting faster.

The 21 drives reviewed in this feature run the gamut from portable players to half-height internal models and include standard single-speed as well as double-speed designs. Many are based on common drive mechanisms: Tandy Corp., Philips Consumer Electronics Co., Procom Technology Inc. (in its Procom PXCDL), and Laser Magnetic Storage International Co. (LMS) all use the same LMS CM205 drive mechanism, for example. Procom (in its SXCDS-C8), Liberty Systems Inc., and PLI base their models on the Sony CDU-541 mechanism; and the two Todd Enterprises' units reviewed here use the same Hitachi mechanisms found in the Hitachi CDR-3700 and Hitachi CDR-3750. CD Technology Inc., MacProducts USA Inc. (in its Magic 3301) and Storage Devices use Toshiba mechanisms.

This review does not cover CD-ROM changers or jukeboxes, which are more appropriate choices if you're considering setting up a server database for your CD-ROM titles. Such systems range from Pioneer's DRM-604X Minichanger ($1,795; 800-527-3766), which holds six disks in a cartridge and includes DOS-compatible software, to Meridian Data's CD Net 314 ($11,245; 800-767-2537), a 386-based ISA system with 8MB of RAM, an Ethernet connection, and two CD-ROM drives. For large LAN server systems, there's the CD Net 428 ($40,745), a package that includes a 486-based EISA system with 16MB of RAM, an Ethernet connection, and 28 CD-ROM drives, also from Meridian Data.

NOT IN TIME

Among the single-disk drives that weren't shipping at test time but which should be available now are: Genesis Integrated Systems Inc.'s $299 GenSTAR 5000i, Micro Design International Inc.'s $895 LaserBank 600CD, PLI's $399 PLI CD-ROM Drive-AT, Sony's double-speed CDU-561 (which the company estimates will sell for between $700 and $1,000), and Toshiba's double-speed XM-3401B (price to be determined). Finally, IBM Corp. was unable to provide its XA-compatible IBM CD-ROM II Drive package ($1,460) in time.

BENCHMARK RESULTS

As PC Magazine Labs' Sequential Throughput test results clearly show, CD-ROM drives aren't going to outpace hard disks anytime soon. But they are getting faster. The first generation of standard single-speed CD-ROM drives still generally have average access ratings of 325 to 380 milliseconds (or about one-third of a second), compared with access times of 20 ms or less (about one-fiftieth of a second) for hard disk drives.

In their standard configurations, all but one of the single-speed drives tested in this roundup maintained the MPC Marketing Council's specified transfer rate (the 2 to 3 percent variation from 150 KBps shown by most products is well within our test's margin of error). The lone exception—the portable Storage Devices SCD-683—uses a parallel-to-SCSI interface, and its slower performance seems directly attributable to the restricted throughput of the parallel port.

HIGHLIGHTS

CD-ROM Drives

AS A CHEAP WAY to distribute mass amounts of information, CD-ROM can't be beat. Disks can hold around 630MB of information, and they can cost as little as $1.50 apiece to produce. The promise of multimedia adds to the CD-ROM appeal. We test 21 single-disk CD-ROM players from 15 vendors.

THE MPC MARKETING COUNCIL'S multimedia specifications call for a CD-ROM drive to have an average seek time of 1 second or less and support a sustained 150-KBps transfer rate, while using no more than 40 percent of the CPU. In their standard configurations, all but one of the drives tested in this roundup maintained a throughput rate of 150 KBps or more on PC Labs' Sequential Throughput test. The Storage Devices SCD-683, which relies on a parallel-to-SCSI connection, was limited by the speed of the parallel port.

THREE DOUBLE-SPEED DRIVES we looked at—the NEC InterSect CDR-74, MacProducts Magic CDR74, and Texel DM-5024—boast sustained throughput rates of 300 KBps. These drives maintain twice the throughput of standard CD-ROM drives by spinning the disk twice as fast, among other factors.

MOST CD-ROM DRIVES require an open expansion slot and a hard disk with considerable storage space. Systems that use proprietary expansion boards can be cheaper than SCSI-based devices, but they often lack SCSI's flexibility of daisy-chaining devices.

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Our 32 Megapixel "Longhorn" Local Bus?... or a 1 Megapixel moo cow? Our "faster-than-a-blink" *Windows accelerator video processing* tied to the speed of your 486 CPU?... or an old-fashioned bottleneck? Our *1MB VRAM controller* producing 1024 x 768 ultra-high, non-interlaced resolution?... or their tired cow VGA? Clearly, the prize goes to the Hyundai New Breed.

Compare our *standard 128KB of zero-wait state cache* with non-cached cows. And don't forget, the Hyundai 433S flexes its processing muscle up to 256KB of cache expansion. This system runs at the head of the stampede!

And we don't just drive the Hyundai stampede, we overdrive it! Double your speed by simply snapping in the *Intel Overdrive™ Processor*. And our advanced "warpspeed" L2 cache and "Longhorn" Local Bus graphics engine give your upgraded system the 32-bit video and fast SRAM you'll need for your higher-speed 486 CPU.

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- 33MHz 486SX w/ 8KB integrated cache
- 32-bit VESA local bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Upgradable to 486DX power via Intel Overdrive™ socket
- 4MB system memory expandable to 64MB on system board
- 170MB 19ms IDE HDD, 32KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs, (2.88MB-ready FDD interface)
- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt and swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 expansion slots, including 1 VESA local bus slot
- 200 watt power supply
- 101 keyboard, 2 button mouse
- Built-in virus protection, front keylock, 2 level password
- MS DOS 5.0 and MS Windows 3.1

Hyundai 433S

Want to talk add-ins? We test our 486 systems with literally hundreds of industry-standard cards and software applications. We test software compatibility on Novell (we're fully certified and a Novell Alliance Program member), Banyan Vines, OS/2 2.0, LAN Manager, and SCO UNIX, plus hundreds of programs running under Windows and MS DOS.

Trouble on the data frontier? Relax. The Hyundai 433S is loaded. A beefy 170MB superfast hard disk, two floppy drives, five external/two internal drive bays, and seven expansion slots mean you won't go hungry for performance. And dressed up with our 14" flicker-free, non-interlaced, color display, the New Breed 433S is the new king of PC country.

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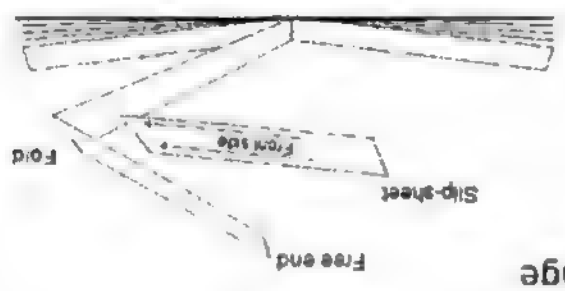
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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   1. Front side touching the free page
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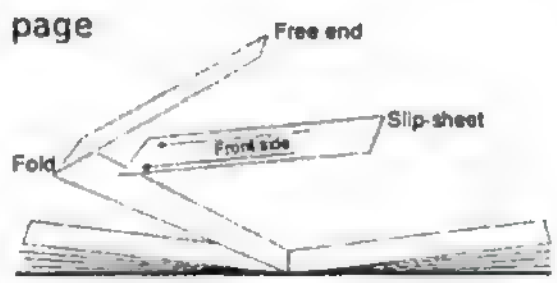

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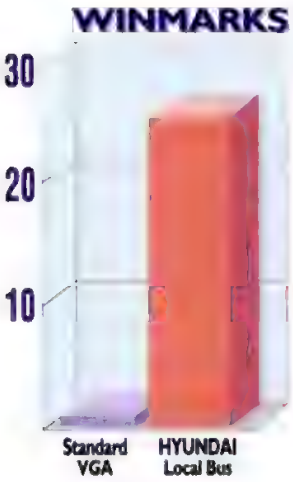
486 STAMPEDE

That thunder you hear on the PC prairie is the New Breed Hyundai 486 stampede. The hardest-charging, price-lean, MIPS-mean herd of computers you'll ever see. We're bringing everything from powerful 66MHz 486DX2 machines to Overdrive-Upgradable 486SX-25 computers. And with our 50MHz 486DX2 desktop PC and 486DX-33 blasters, you can handle today's demanding applications.



Do something "Longhorn" Local Bus.

That flash you see on the graphics horizon is the image of our Windows processing power triggering the Hyundai 486 stampede.

Your 486 processor was meant to run today's applications. So why rein in all that power? That out-to-pasture, 16-bit VGA card can only deliver 2 Megapixels at best. That's already dated technology. Let her rip with 32-no-blink-bits of "Longhorn" *Local Bus video acceleration.* And with up to 32 Megapixels *standard*, believe it, you'll see an incredible difference in Windows performance.

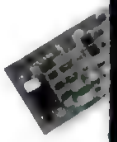
Do something thunderbolt.

Lightning-fast *"warpspeed" L2 caching* is another max-performance feature that's designed into every Hyundai 486. Thunderbolt write-back operations blast your DOS, Windows, or OS/2 data into a box canyon of ultra-fast SRAM. Start out with 128KB standard (more than the cow computers), then expand to 256KB to handle today's big applications. Cache hit for cache hit, the Hyundai 486 Family, with 128KB standard caching, delivers twice the MIPS of non-cached cows.

Do something upgradable.

The Hyundai 486 New Breed Family is designed in Silicon Valley, U.S.A., to out-perform the herd.

All of our systems are *CPU-upgradable* through a single chip via a *ZIF or Overdrive socket*, so the New Breed lets you double your speed. We won't let tomorrow's 32-bit operating systems blast a hole in your productivity. Just upgrade your Hyundai 486 to any higher-speed Intel 486 CPU in the future.



AND PUT THE OLD BREED OUT TO PASTURE.

Every cow has its day. But it's time to put that milker out to pasture and make way for the Hyundai 486 stampede. It's time to Do Something New Breed®.

Say goodbye to "cow-shed" engineering and mother-board-of-the-month manufacturing. At Hyundai, we're doing *U.S.-based, end-to-end, value engineering and manufacturing.* That means benchmark-blasting power from the new Hyundai family of 486 Systems.

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- Upgradable to 486DX power via Intel Overdrive™
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- 80MB 17ms IDE HDD, 32KB disk buffer
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- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Other hard drive, video, memory, and monitor options available

$2369 Hyundai 433D

- 33MHz Intel 486DX w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 4MB system memory expandable to 64MB on board
- 200MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Available in floor-standing server model as 433DT, call for price
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$2599 Hyundai 450D2

- 50MHz Intel 486DX2 w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 8MB system memory expandable to 64MB onboard
- 200MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
- Other hard drive, video, memory, and monitor options available

$2995 Hyundai 466D2

- 66MHz Intel 486DX2 w/8KB integrated cache
- 32-bit VESA Local Bus UVGA graphics w/1MB VRAM
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Processor upgradable via ZIF socket
- 8MB system memory expandable to 64MB on board
- 360MB 12ms IDE HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2 button mouse
- Built-in virus protection, front key lock, 2 level password
- MS DOS 5.0 and MS Windows 3.1
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The PC range war can shake everybody's confidence. Except ours. We're a $50 billion global company, which means we have the resources to guarantee outstanding service and support. When you buy New Breed technology, you get New Breed service from a worldwide leader.

In addition to our service and support, we have a TQC (Total Quality Care) program that makes us the double-safe buy. Our 18-month warranty on all systems is a soft ride in the saddle.

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- **7-days-a-week tech support:**
  - **—24-hour lifetime tech support: 800-289-4986.**
  - **—24-hour tech fax: 800-283-4986.**
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- 66MHz 486DX2 CPU w/8KB integrated cache
- 128KB high-speed L2 cache
- 32-bit EISA architecture
- 8MB RAM standard (expandable to 32MB on system board and 96MB via memory expansion board)
- 32-bit caching SCSI host adapter
- 360MB 12ms SCSI HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- SVGA graphics card
- 14" interlaced, ultra-high resolution, flicker-free, color display with 1024 x 768 resolution, .28 dot pitch, 72MHz refresh rate
- Seven 32-bit EISA slots, one ISA slot
- 5 external and 2 internal drive bays
- 300 watt power supply
- Built-in virus protection, front keylock, 2 level password
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Number of PCs installed 486_____ 386_____ 386SX_____ 286_____

Tell us about your targeted system configuration

CPU Type	❑ 486	❑ 486SX	❑ 386DX	❑ 386SX	❑ Notebook	
Architecture	❑ ISA	❑ EISA				
Memory	____MB installed	Cache Memory	❑ 128 KB	❑ 256KB		
Floppies	❑ 1.44MB 3-1/2"	❑ 1.2MB 5-1/4"				
Hard Disks (IDE)	❑ 100MB	❑ 120MB	❑ 200MB	❑ 250MB	❑ 330MB	❑ 500MB
(SCSI) **3.5"**	❑ 360MB	❑ 540MB	❑ 1.2GB			
5.25"	❑ 330MB	❑ 760MB	❑ 1.6GB	❑ 2.0GB		
	❑ Tape____MB	❑ Sound Card	❑ Other_____	❑ Fax/Modem	❑ CD-ROM	

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The Liberty 115 Series CD-ROM drive, for example, yields 150 KBps using its standard SCSI connection, but only half that when using the optional parallel-port adapter that the company also sent for testing.

TWICE AS FAST

A second generation of faster drives (265 ms to 280 ms) is now raising the bar in the market. Ushered in by NEC Technologies Inc. nearly a year ago, these so-called double-speed drives double average data transfer rates. Spinning disks at 400 to 1,060 revolutions per minute (rpm), the 300-KBps players in this review—the NEC InterSect CDR-74, MacProducts Magic CDR74 (based on NEC's CDR-74), and Texel DM-5024—improved throughput nearly twofold over standard single-speed drives on our tests. (For more information on how double-speed drives work, read the sidebar "Double Speed".)

Keep in mind that our tests do not reflect the rate of CPU utilization. To truly meet the MPC Marketing Council's multimedia specifications, a CD-ROM drive must support an average seek time of one second or less and a sustained transfer rate of 150 KBps using no more than 40 percent of the CPU.

WHAT TO LOOK FOR

To handle a CD-ROM player, you'll need an open expansion slot and a hard disk with considerable storage space. CD-ROM titles can take anywhere from half a megabyte to 4.5MB of hard disk space for their own search programs.

Several drives that we saw, such as the Sony CDU-31A-02 and the LMS offering, still require proprietary expansion boards. In some cases this means you won't be able to daisy-chain devices; or if you can, they will usually have to be the same model drive (as with the Sony, which supports up to four devices in a daisy chain). Other drives use standard SCSI (or SCSI II) kits that can support up to seven different SCSI devices. Make sure you choose a product whose interface will be flexible enough to meet your needs. In this review, we saw seven systems that relied on proprietary interfaces, while the others used SCSI or parallel-to-SCSI connections.

When choosing a drive, also note the

PC MAGAZINE ▶ EDITORS' CHOICE

• NEC InterSect CDR-74

Few performance differences separate the men from the boys in this roundup of 21 CD-ROM drives. On PC Labs' Sequential Throughput test, most of the drives with average sustained transfer rates of 150 KBps performed at that level. The only exceptions were devices that we tested via standard or optional parallel-to-SCSI port adapters; these delivered less than half that throughput. The three double-speed drives (from NEC, Texel, and MacProducts) performed very close to their 300-KBps throughput ratings.

The performance differences we found had to do with each drive's ability to play MPC motion video clips smoothly and deliver audio with little or no distortion (even at the highest volume). Some drives in this review displayed noticeable pauses in video or experienced minor problems delivering good-quality audio. Many more, including the 280-ms NEC InterSect CDR-74, performed up to par in those departments. What makes the double-speed NEC InterSect CDR-74 a winner is its solid mix of price, durability, and performance.

At $725 for the external drive without the 8-bit Trantor Systems ISA SCSI adapter—and expected to sell on the street for about $600—the NEC CDR-74 represents a better bargain than the identical system that MacProducts acquires and sells for $699, under the name of the Magic CDR74. (Because MacProducts sells direct, you won't find a discounted street price.) With its SCSI interface, the NEC CDR-74's list price of $814 still provides a better value than the $848 price of a comparably configured version of the Magic CDR74. And NEC adds the advantage of toll-free technical support.

The NEC CDR-74 combines its good price and performance value with reliability; its dust-busting design includes a double door and a self-cleaning lens. These features are backed by a two-year warranty and the reputation of a company that was first to market with a double-speed drive mechanism.

Support for the Photo CD format, as well as the ability to be upgraded to support CD-ROM XA, further enhance the appeal of the NEC unit. If you're looking for a drive that provides maximum performance today and is prepared for the future, the NEC CDR-74 (or its internal counterpart, the $649 NEC CDR-84) certainly merits your consideration.

LOW-COST ALTERNATIVE

If price is your primary consideration and you're willing to forego the flexibility of a SCSI interface, consider the external Procom PXCDL. Based on an LMS CM205 mechanism and a proprietary interface, the PXCDL sells for a low $395 without any software titles and only $545 with its bundle of four CD-ROM applications. Or, if you prefer an internal drive, Procom offers the same model for $325.

CLOSE, BUT...

The Texel DM-5024—$699 with SCSI adapter—is a double-speed drive that offers a good list price (but sold direct, so you won't see discounts). The product delivers speed and supports a variety of formats, but the tested unit had a few drawbacks: It lacked a utility to play audio CDs (although the company says it should be shipping one by the time you read this) and a faulty driver caused a problem on our first attempt at installation.

number of memory-address settings and IRQs the interface card supports. If you can't select different IRQs or addresses, installing a CD-ROM drive on a PC that already contains several devices may prove difficult.

The last basic items that you'll need are software drivers. Microsoft's MS-DOS CD-ROM Extensions (MSCDEX) are required to translate the CD-ROM's ISO 9660 file format into DOS's file-allocation format. Make sure you're using DOS 3.1 or later and that the vendor supplies the current version (Version 2.21) of MSCDEX.

There are two basic CD-ROM drive designs: those that use a standard Sony-style CD-ROM caddy case for disks (15 of the 21 products in this review) and those that use a traditional tray or drawer like audio CD players. Caddies protect disks from oily fingers and dust, but they are awkward when you need to change disks. (Additional CD-ROM caddies can be purchased for about $11 to $14 each.) Tray designs are easier to manage (especially if you switch titles frequently), but they run the risk of allowing dust and dirt to get in and disable the drive. Several makers of both caddy and caddyless drives use self-cleaning lenses or double-doors to help deter the influx of dust.

IN QUEST OF MULTIMEDIA

For many users, the motivation for buying a CD-ROM drive will be multimedia. The MPC Marketing Council only licenses its logo for complete upgrade kits and PCs, though, so you won't see its stickers on separate CD-ROM drives. You should also note that the Council does not test or certify products that bear the MPC imprimatur.

For a multimedia setup, make sure the drive package you choose has an audio output for hooking up a sound board. Most sound cards, with the notable exception of the Microsoft Windows Sound System ($289), have an internal three-pin or four-pin connector for receiving analog audio from an internal CD-ROM drive. The connectors are not standardized, however, so make sure you order the correct cables.

Most external CD-ROM drives have stereo audio outputs in the form of RCA-style mini jacks. Using the external jacks, audio can easily be fed into the external audio input of an audio card. All the drives we tested could play standard audio CDs. The systems all also included headphone jacks.

A WORLD OF FORMATS

Besides MPC titles and audio CDs, what else can you play on your new CD-ROM drive? There's much confusion over what drives can handle which formats, and there's a shelfful of "book" specifications that apply to those silvery disks: Red Book (audio CD), Yellow Book (CD-ROM), Green Book (CD-Interactive), and Orange Book (CD Recordable).

The basic data format for CD-ROMs in the DOS world is the ISO 9660 specification (an update of the 1985 High Sierra proposal). ISO 9660 describes the logical structure and file format for CD-ROMs, and the Yellow Book standard describes the manner in which data should be laid down on a CD-ROM disk. There are thousands of ISO 9660 CD-ROM titles that will play on all the drives in this roundup.

There's much confusion over what drives can handle which formats, and there's a shelfful of "book" specifications that apply to those silvery disks.

Hoping to bring interleaved text, sound, and video to home entertainment systems, Philips followed up the Yellow Book with the Green Book, for CD-Interactive (CD-I). The fortunes of this format, for which there are only about 75 titles, have risen and fallen according to how strongly it's been marketed. Currently, it is being heavily promoted (again) by Philips in TV ads featuring *Terminator 2*–style special effects.

The Green Book specifies not only a data format, but specific playback requirements as well. So while a company may claim its CD-ROM drive is CD-I compatible, there's no guarantee that all CD-I titles will play on it. Strictly speaking, only Philips' CD-I home players (not reviewed here) are completely CD-I compatible.

Liking some of what they saw in CD-I, Sony and Microsoft began supporting a subset of the CD-I standard called CD-ROM XA (Extended Architecture). This borrows ADPCM (adaptive differential pulse code modulation) audio compression from the CD-I standard with the option of interleaving audio, video, and text. The most significant difference between CD-I and CD-ROM XA is that the XA format does not restrict the type of playback mechanism. Consequently, despite the similarities between formats, a CD-ROM player that can playback CD-ROM XA disks may not necessarily be able to manage CD-I software.

In order to play an XA disk, the information read by the drive needs to be decoded differently than that from a standard CD-ROM disk. The Sony and Texel models reviewed here are XA-compatible out of the box, and several of the other drives we tested can be upgraded. Such upgrades are possible by changing the software, firmware, or host adapter card. Many drives may not be upgradable to CD-ROM XA, however, because they may require special firmware in order to read and decode compressed data.

Creating further format confusion, Sony recently introduced its $1,000 Multimedia CD Player. The hand-held device includes an LCD screen, internal speaker, and keypad, and will play XA disks—but it won't play most existing MPC software titles. Sony is now pushing yet another standard for these players called MMCD (MultiMedia CD).

The last book (so far) on the CD shelf is the Orange Book, developed for CD Recorders (read the sidebar "Desktop CD-ROM Recorders: The In-House Recording Solution"). Roughly speaking, this book lays out the technical details about blank media and where on the disk the additional information needed to make such recordings should be placed. It is possible under the Orange Book specification to record ISO 9660–compatible file format CD-ROMs that can then be played back on standard CD-ROM players. However, recordings must be made in a single pass or session. Though you can continue to append additional information on blank disks (so-

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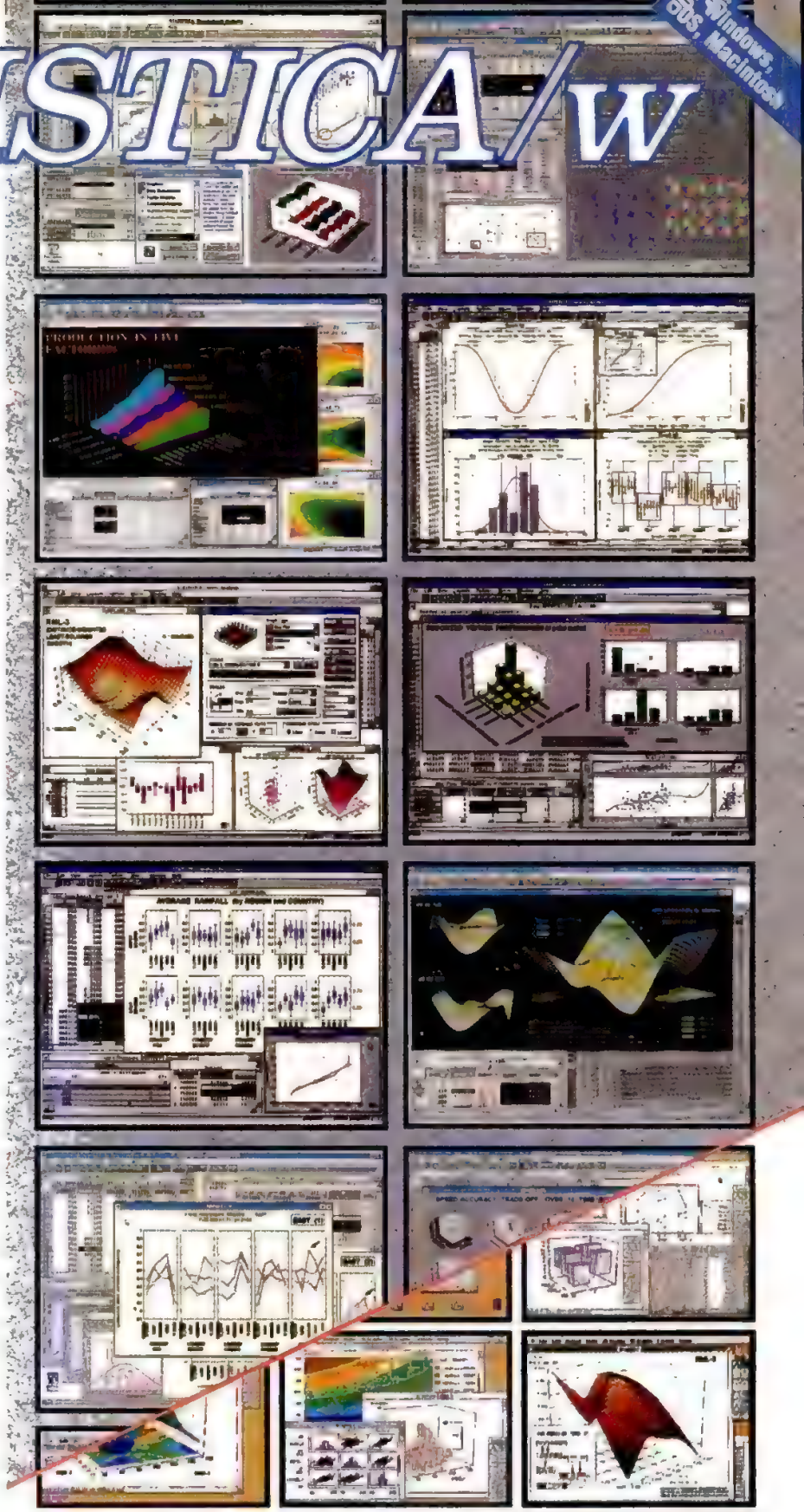

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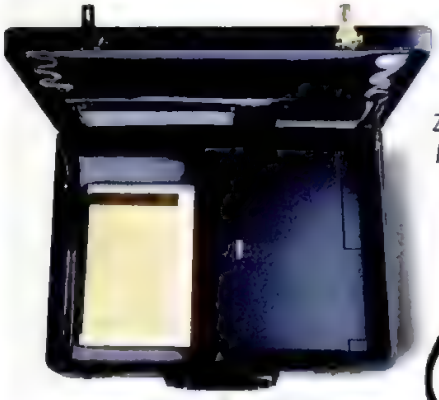

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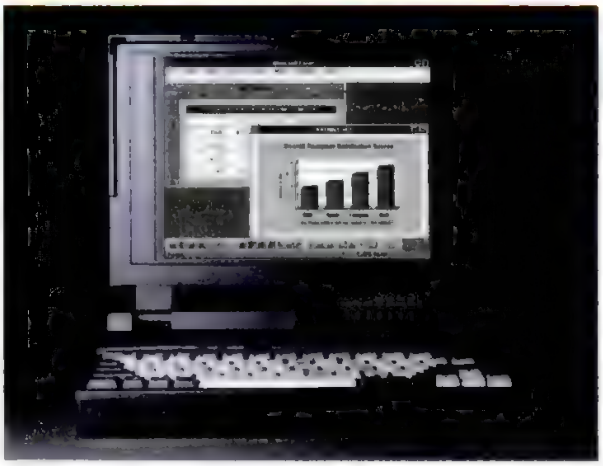

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called multisession recording), standard ISO 9660 CD-ROM drives will only recognize the first session that was recorded.

An association of manufacturers known as the Frankfurt Group is currently discussing an amendment to the Orange Book specification that will outline a standard for multisession recordings. Kodak's Photo CD format is a proprietary multisession specification, although the company's recordable systems produce only single-session disks; you can't add more photos later. Kodak plans to introduce true multisession Photo CD recording systems early next year, but current CD-ROM drives that claim Photo CD compatibility can actually only read single-session CDs. (Trantor Systems offers a third party solution, the $99 T130 SCSI adapter with software, that can teach your old CD-ROM to read Photo CD.)

The drive you buy today isn't likely to be upgradable to read multisession disks, either. That's because in order to read such recordings, CD-ROM players will require at least a firmware change, as well as a replacement for Microsoft's MSCDEX. By early next year, though, several CD-ROM manufacturers are expected to introduce players that will support multisession Photo CDs.

Even all of this still won't put full-motion video on your PC. In order to do that, a video compression standard needs to emerge. The major contenders—Microsoft's AVI (Audio Video Interleave), Intel's real-time video DVI (Digital Video Interactive), and Apple's uik-Time—all lack the ability to play back high-resolution, 30-frame-per-second full-motion video from a CD on a PC.

Despite the confounding array of formats, the future for CD-ROM looks bright. There is a growing number of software titles (for more information on that subject, read the story "27 Good Reasons to Buy a CD-ROM Player" in this issue), and manufacturers continue to attempt to cram more data on the disks, with Sony currently working on a blue semiconductor laser that could extend the current 74-minutes of Red Book audio on a CD to up to three and a half hours. Such technology may be years away, but in the meantime, there are plenty of inexpensive drives that can bring volumes of information to your PC.

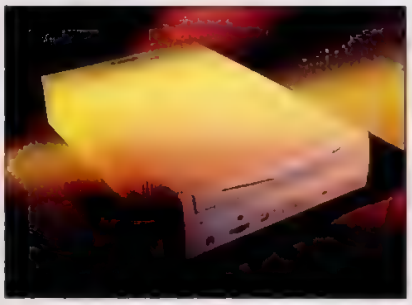
CD Technology Inc.

CD Porta-Drive Model T3301

BY HENRY FERSKO-WEISS

If you're looking for a CD-ROM drive that won't have to stay on the desktop, CD Technology's portable CD Porta-Drive Model T3301 is tiny, light, and mobile. This drive weighs only 3.0 pounds and measures 2.0 by 6.0 by 9.6 inches (HWD).

By itself, the Model T3301 costs $795 (its street price runs near $599). With the ISA SCSI adapter supplied for testing, the unit sells for $995. Its optional travel gear includes a fairly costly $300 rechargeable 0.4-pound nickel cadmium battery (good for one hour of operation), a rather high-priced $220 parallel-port adapter (not reviewed here), and a $60 soft carrying case, which lets you sling the unit over your shoulder. A half-height internal version of the device, the CD Porta-Drive T3301 INT, is also available and lists for $650.



FACT FILE

CD Porta-Drive Model T3301
CD Technology Inc., 766 San Aleso Ave., Sunnyvale, CA 94086; 408-752-8500; fax, 408-752-8501

List price: With AC power supply, caddy, cables, $795. CD Porta-Drive T3301 INT internal drive, $650; ISA SCSI adapter kit, $200, parallel-port adapter kit, $220, MCA SCSI adapter kit, $300, Macintosh device driver, $25, Macintosh cable, $20; rechargeable nickel cadmium battery, $300, CD-Audio Music Box, $60; Compton's MultiMedia Encyclopedia and Guinness Disk of Records, $250, pack of five disk caddies, $60, soft carrying case, $60

Requires: 8K RAM, DOS 3 3 or later

In short: The CD Porta-Drive Model T3301 is built for travel and can be paired with a rechargeable battery and a parallel-port adapter—though these are rather costly. A SCSI interface is available for desktop work Its separate power supply, self-cleaning lens, double door, and automatic power-down feature bode well for reliability, but we did notice pauses in motion video

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The external Model T3301 has a separate AC power supply, which adds only a half pound to the drive's carrying weight. According to a company spokesperson, having a separate power supply makes the drive more reliable by keeping heat away from the circuit board and reducing the potential for attracting dust. Other protection against dust includes a self-cleaning lens and a double door that completely seals the mechanism. The company specifies a 50,000-hour mean time between failures (MTBF) rating for this drive.

The Model T3301 uses a 325-millisecond (ms) Toshiba T3301 mechanism, the company's own brand Sony-compatible caddy, and an 8-bit SCSI II controller from Future Domain. The unit includes a 64K buffer, supports the Kodak single-session Photo CD format via an optional device driver, and can be upgraded to support CD-ROM XA.

INSTALLATION AND OPERATION

Installing the Model T3301 takes only minutes. We didn't have to change the factory-set jumpers on the SCSI controller (though it does provide a choice of two IRQs and six memory addresses), and the software installation is automatic.

Similar to a notebook computer, the Model T3301 automatically powers down after being idle for 30 seconds.

PC Magazine Labs' tests of sequential-read throughput showed few differences among the drives. Informal tests of motion video clips with the Model T3301, however, revealed pauses in the action. A company spokesperson says that CD Technology hasn't heard any other reports of video pauses, and had no explanation. The drive responded well to informal text searches, though, and produced good-quality audio. When using the parallel-port to SCSI adapter, you should expect to see a fairly significant decrease in speed.

Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.2, is included with all of the interface kits that

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Performance Tests: CD-ROM Drives

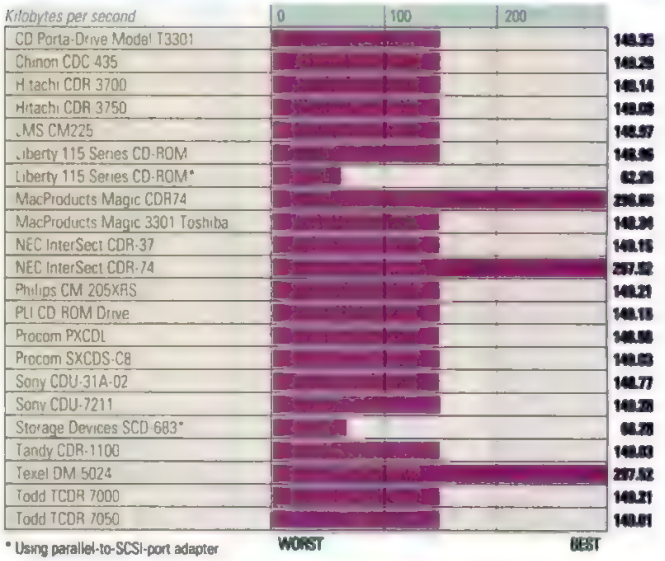
Most of the drives produced results similar to others with the same throughput ratings. The exceptions used standard or optional parallel-to-SCSI-port connections, delivering about half the throughput of 150 KBps drives.

The **Sequential Throughput** is calculated by measuring the average time required to read 16-, 32-, and 64-kilobit blocks from a 13MB file. This test reflects the drive's performance during such operations as loading programs and large data files.

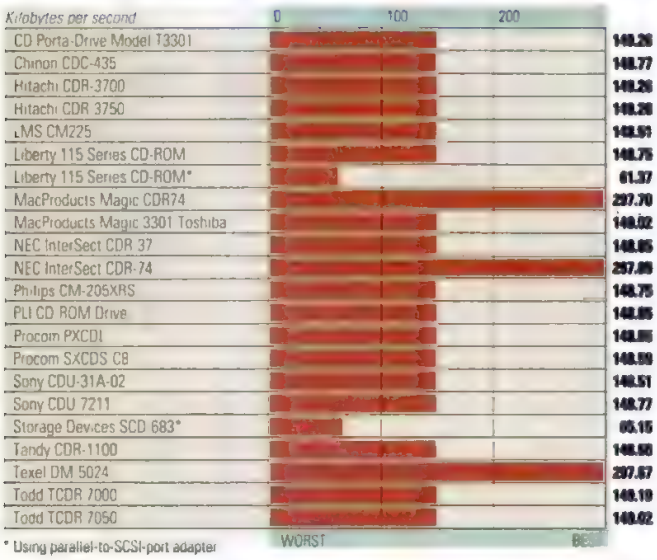
HOW WE TESTED

For these CD-ROM drives, PC Magazine Labs performed the Sequential Throughput test using a Compaq Deskpro 386/25e with 8MB of RAM and a 310MB ESDI hard disk. Our test accesses the MSCDEX driver through DOS and thus represents the worst possible case, since most application programs should access the driver directly. A 2 to 3 percent variation in test results, as compared with the MPC standard, is not unexpected; such a variation does not mean the drive fails to meet that specification.

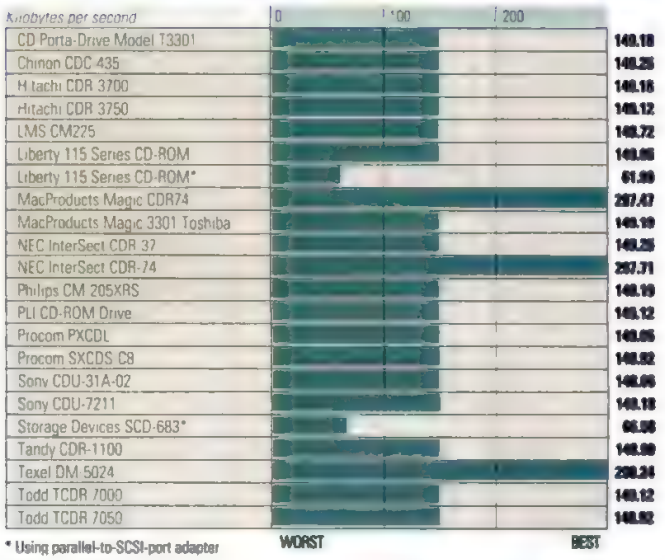
SEQUENTIAL THROUGHPUT (32K Block)



SEQUENTIAL THROUGHPUT (16K Block)



SEQUENTIAL THROUGHPUT (64K Block)



the company offers. Unlike many other units, however, the audio play software, CD-Audio Music Box, is a $60 option. The Model T3301 includes a headphone jack as well as two RCA jacks and a volume control switch.

One minor drawback of this drive is its lack of a power switch: The only way to turn the unit on and off is through the plug. The power supply does have a power indicator, and when you operate off the battery pack you'll hear beeps every five seconds to indicate you're getting power. A company representative says this acts as a reminder to turn the drive off when you're not using it and save battery life, but some users may find the beeping annoying.

Despite the pauses our unit experienced with motion video, the CD Porta-Drive Model T3301 is a product to consider. It's well suited to those who need a drive that can function as a SCSI desktop device, as well as an on-the-road unit—as long as you are willing to pay the price of CD Technology's fairly high-cost battery and parallel-port adapter options.

Chinon America Inc.

Chinon CDC-435

BY HENRY FERSKO-WEISS

The $895 Chinon CDC-435, from Chinon America Inc., offers one thing no other CD-ROM drive in this group does: a 12-function infrared remote control for when you want to use the drive as a CD music player. The digital display on the front control panel highlights track numbers and also gives you error codes for

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FACT FILE

Chinon CDC-435

Chinon America Inc., 615 Hawaii Ave., Torrance, CA 90503; 800-441-0222, 310-533-0274; fax, 310-533-1727

List price: With ISA SCSI adapter, AC power supply, caddy, infrared remote control, cables, CD Audio Play, Selectware sample CD disk, $895; CDS-435 internal drive, $695; Macintosh interface kit, $150.

Requires: 7K RAM, DOS 3.2 or later.

In short: A unique feature of the Chinon CDC-435 is its infrared remote control that can be used to control CD audio selections. But this drive (based on a Chinon 435 mechanism) has no built-in dust protection, though it comes packaged with a lens cleaning disk. Also, while it supplies good quality audio and kept up with the other units on our throughput tests, it exhibited pauses in motion video clips.

ON READER SERVICE CARD

troubleshooting. While the infrared remote is an enticing feature, the CDC-435 has its flaws. These include pauses in motion video clips and a lack of built-in protection against dust. On the plus side, the CDC-435 does support Kodak's Photo CD format (single-session format, like most drives).

Chinon uses its own drive mechanism (the 350-millisecond Chinon 435), 16-bit SCSI controller, and driver software. The caddy is Sony's. The ISA SCSI interface comes included in the list price; a Macintosh interface kit costs $150. You should be able to find the drive on the street for $549 to $579; a half-height internal version, the CDS-435, lists for $695, or $399 on the street.

The price of the package includes Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.21, and CD Audio Play software. Dual RCA jacks are located in the back of the drive; there is also a headphone jack and a volume control.

SMOOTH GOING, FOR THE MOST PART

The hardware installation was straightforward; we didn't need to change any of the factory-set jumpers on the board or dip switches on the drive for our test configuration. If memory address conflicts arise in your configuration, the system's support of 16 selectable addresses is welcome.

You get a 64K firmware buffer, but the software cache size set by the automatic installation routine was 8K rather than the 16K the manual says is the default. Even after we reset the cache to 16K, the motion video clips showed noticeable pauses. But on PC Magazine Lab's Sequential Throughput read tests, the drive performed consistently with the others that specify transfer rates of 150 kilobytes per second (KBps). In application use, text searching also seemed on a par with other drives we looked at; audio quality was quite good, with almost no perceptible static or distortion, even at a high volume.

LITTLE DUST PROTECTION

Although the CDC-435 is well constructed, it lacks built-in features to protect against dust such as a self-cleaning lens, double doors, and a sealed enclosure. Instead, the company provides a lens-cleaning disk.

The remote control for audio CD play of the Chinon America CDC-435 may be intriguing and audio quality is quite good, but there are other drives available that are cheaper and that offer automatic protection against dust and smoother motion video play.

Hitachi Home Electronics (America) Inc., Multimedia Systems

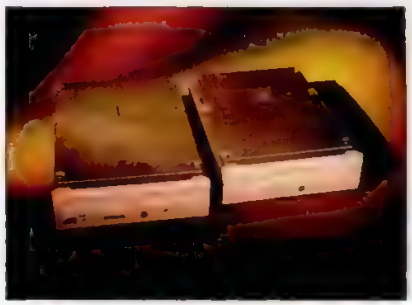
Hitachi CDR-3700
Hitachi CDR-3750

BY GREG PASTRICK

Hitachi is one of the big names in supplying the industry with drive mechanisms for CD text retrieval and multimedia applications. The 300-millisecond (ms) Hitachi CDR-3700 and Hitachi CDR-3750 half-height internal drives are the latest devices being delivered by the company. The two units are also among the higher-priced of those offerings with a rated sequential throughput in the 150-kilobyte-per-second (KBps) range.

Priced at $865, the CDR-3700 comes as a complete plug-and-play package that provides a proprietary PC interface card, ribbon cable, driver and installation software, and Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.21. With the CDR-3750, the same $865 price buys you only the drive itself. You'll have to pony up another $180 for the SCSI II interface, ribbon connector cable, driver, and installation software, and MSCDEX Version 2.21.

Each drive is easy to install, and the setup software's default settings quickly configure the drives for solid operation. Both units come with the near-standard 64K memory buffer that contributes to each drive's virtually smooth performance in playing motion video clips. The



FACT FILE

Hitachi CDR-3700

List price: With proprietary ISA adapter, cables, caddy, audio CD software, $865.

Requires: 12.4K RAM, DOS 3.1 or later.

Hitachi CDR-3750

List price: With caddy, $865; ISA SCSI adapter kit with audio CD software, $180.

Requires: 23K RAM, DOS 3.1 or later.

In short: Hitachi's latest CD-ROM drives are fine-performing devices with smooth video play, but you pay top dollar for 150 KBps sequential throughput with 300 ms access. Of the two (based on Hitachi's own drive mechanisms), the SCSI-based CDR-3750 is the preferable option because it provides more flexibility and slightly better sound, but it costs $180 more when you factor in the interface kit.

Hitachi Home Electronics (America) Inc., Multimedia Systems, 401 West Artesia Blvd., Compton, CA 90220; 800-369-0422, 310-537-8383; fax, 310-515-6223

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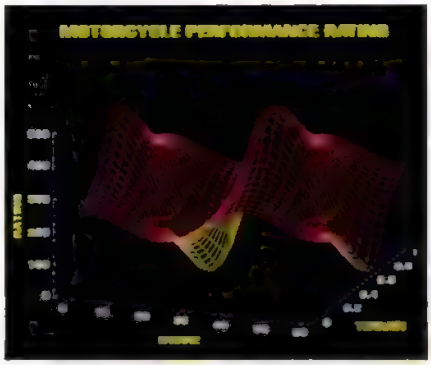

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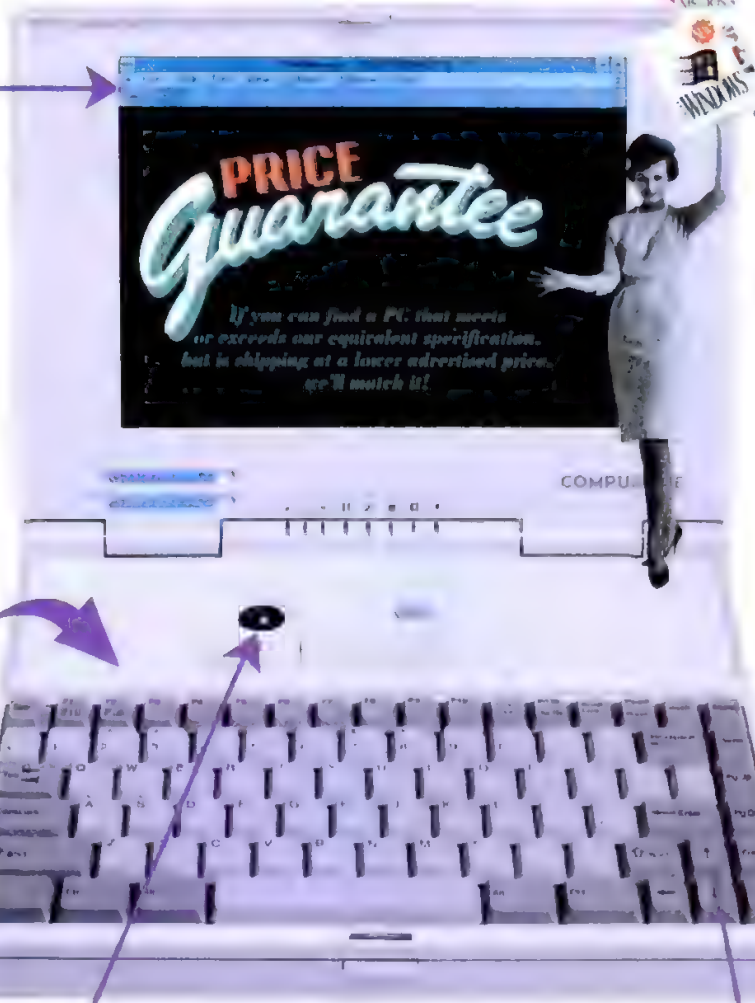

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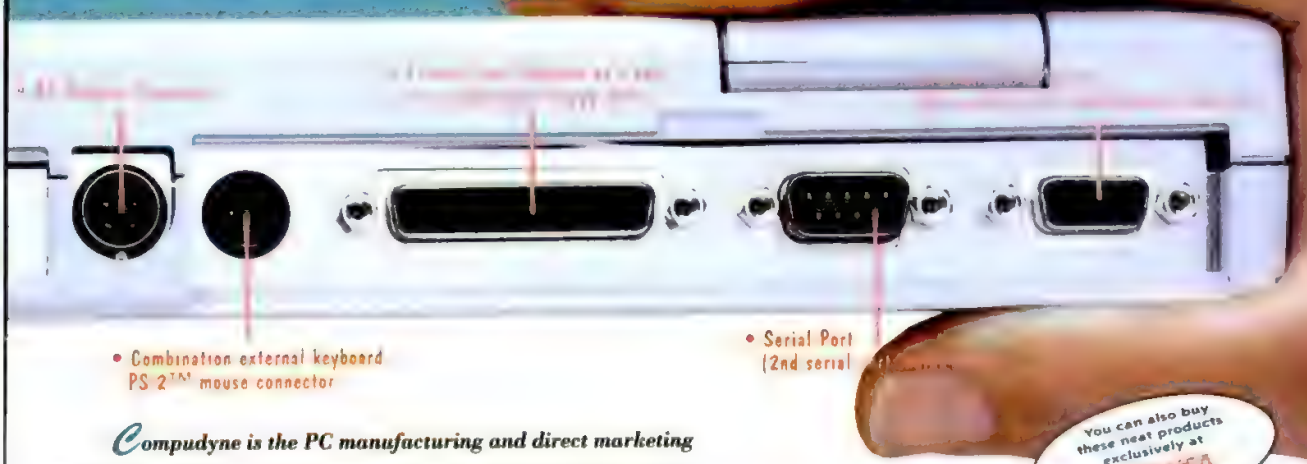

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installation software efficiently updates the AUTOEXEC.BAT and CONFIG .SYS files, sets aside a minimum of 16K for buffering, and automatically recognizes the presence of EMS for use by MSCDEX. The software that comes with the CDR-3700 drive and with the CDR-3750's SCSI interface includes a CD driver and a utility so you can use the drives to play audio CDs.

Both drives boast undistorted audio at full volume through the headphone jacks, but (unlike some other internal drives) neither the CDR-3700's 8-bit proprietary PC interface nor the CDR-3750's 8-bit Future Domain SCSI interface comes with external RCA jacks. The sound quality of the CDR-3750 is slightly superior to that of the CDR-3700.

On raw throughput the drives are a close match to each other, as well as to the other systems in this review that have 150-KBps transfer rates. Each unit allows chaining of an additional seven CD-ROM devices.

The units support the Photo CD (single session) and CD-Interactive formats. Support for CD-ROM XA requires third-party drivers.

Street prices for both the CDR-3700 and CDR-3750 knock off $100 from the list price for the drive units, not including interface and software in the case of the CDR-3750.

Hitachi still offers its older, third-generation external models, the Hitachi CDR-1700S and Hitachi CDR-1750S (reference the October 29, 1991, issue of *PC Magazine* for a review of the latter), for $995 and $1,095, respectively, in configurations that include interface cards. The CDR-1700S also uses a Hitachi proprietary interface, but offers only a 32K buffer; the CDR-1750S relies on a SCSI interface but, unlike the CDR-3750, does not support the SCSI II standard. Additionally, the CDR-3700 and CDR-3750 both boast faster access times than the older drives.

The Hitachi CDR-3700 and Hitachi CDR-3750 are quality multimedia-capable devices with self-cleaning lenses, sealed drive doors, good motoring, solid throughput measures, and long-lasting reliability. These two offerings face tough competition from double-speed drives that list for nearly the same price or less, though.

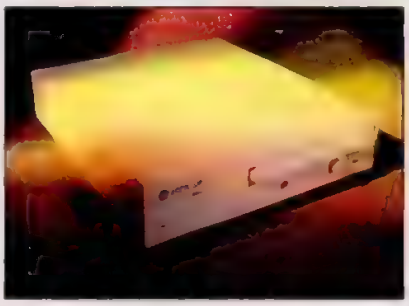
Laser Magnetic Storage International Co.

LMS CM225

BY JOHN R. QUAIN

A wholly owned subsidiary of North American Philips Co., Laser Magnetic Storage International Co. (LMS) stands out in the CD-ROM crowd not as a result of its product's uniqueness, but rather because of the device's ubiquity. The drive mechanism in the LMS CM225 is manufactured by LMS, but it is also purchased and repackaged by other CD-ROM purveyors, including Tandy Corp., Procom Technology, and Philips Consumer Electronics Co.

LMS's external CM225 CD-ROM player ($630) is essentially the same package as the external Procom PXCDL ($395), the internal Tandy CDR-1100 ($399.95), and the internal Philips CM-205XRS ($599). (LMS sells its half-height internal version, the LMS CM205, for $490.) As with those other models, the LMS drive comes standard with a proprietary 8-bit host adapter, as well as proprietary drivers and installation software.



FACT FILE

LMS CM225

Laser Magnetic Storage International Co., 4425 ArrowsWest Dr., Colorado Springs, CO 80907-3489; 719-593-7900 (sales); fax, 719-531-0168

List price: With ISA proprietary adapter and cables, $630, LMS CM205 internal drive, $490, MCA interface kit, $330

Requires: 25K RAM, DOS 3.3 or later

In short: Laser Magnetic Storage is a popular CD-ROM drive maker, especially among other manufacturers. The LMS CM205 drive mechanism in its LMS CM225 player is the model upon which three other companies in this roundup have based their own offerings. The LMS model offers good performance, but lacks extras (such as bundled software and toll-free support) that some of the other companies provide.

461 ON READER SERVICE CARD

Consequently, with its 32K buffer and 375-millisecond (ms) average access rating, the LMS drive performed comparably to the other three on PC Magazine Labs' Sequential Throughput test. The performance differences among all the models with throughput ratings in the range of 150 kilobytes per second (KBps) were, in fact, statistically insignificant.

Designed for convenience, the LMS player features a pop-out tray to handle disks without a caddy. The drawback here is that the tray design does not provide maximum dust protection and must be pulled out slightly to insert disks, but the caddyless operation can be a blessing if you frequently change software titles.

On the front of the LMS CM225 there's a mini headphone jack and a volume control knob. On the back, stereo audio RCA jacks enable you to hook up the player to a sound card or external speakers.

The CM225 has a unique method of playing audio disks without any software: By pushing the volume control knob, the player will start playing an audio disk from the first track. You can jump ahead to successive tracks by pushing the knob again. Listening to audio using the front headphone jack produced ample volume with a minimum of distortion even when the volume was raised to its maximum. Furthermore, motion video played from MPC disks moved smoothly, without any of the lagging or halting images experienced with the Tandy version of the drive.

Though not as flexible as a standard SCSI interface, installing LMS's proprietary 8-bit adapter should be a trouble-free experience for most users. If conflicts arise, the adapter's defaults can be changed to one of four IRQs (3, 4, 5, or 6) and can use one of four different memory allocations.

The internal version of the LMS drive can be upgraded to support the CD-ROM XA format, via a $499 interface card (made by Philips) that will be available by mid-year.

Shoppers are likely to find that the dif-

ferences in price between the LMS-based CD-ROM players in this roundup will be narrowed by dealer discounts. At press time, LMS estimated discounts of 15 percent to 20 percent. Software bundles—like those offered by Philips and Procom—and service and support may be a better guide to most users' buying decisions here. Without any included CD-ROM titles or toll-free phone support, prospective buyers may find the LMS CM225 falls a little short, despite its good performance.

Liberty Systems Inc.

Liberty 115 Series CD-ROM

BY HENRY FERSKO-WEISS

The $699 Liberty 115 Series CD-ROM, from Liberty Systems, is a cross between a desktop and a portable CD-ROM drive. Although it doesn't have a battery option, it is compact enough for travel: 1.9 by 6.8 by 9.6 inches (HWD) and a mere 4.5 pounds. You can also connect the drive to the parallel port with an optional $100 adapter and pack everything away for travel in a $29 soft carrying case. The drive's performance was decent overall, though motion video wasn't entirely smooth.

An 8-bit SCSI adapter, by Trantor Systems, costs an additional $89. Liberty Systems sells direct, so don't expect any price discounts. With either the SCSI or the parallel-port adapter kit, you get audio play software that lets you use the drive (which includes headphone and RCA jacks, as well as a volume control) for music CDs. An MCA interface kit costs $259. There is no internal version available.

The sleek-looking black drive has both power and busy indicators on the front panel, and it is solidly constructed. The drive mechanism in the 115 Series is the Sony CDU-541. The lens is self-cleaning, but the enclosure isn't protected from dust. At test time, the package supported Kodak's single-session Photo CD format.

PERFORMANCE

Using its SCSI connection, the 115 Series drive's performance scores were consistent with the other units we tested that are rated at 150 kilobytes per second

Desktop CD-ROM Recorders: *The In-House Recording Solution*

by John R. Quain

Although desktop CD-ROM publishing systems have been available for a couple of years, prices well in excess of $20,000 have kept them from reaching many offices. If you needed to create a handful of CD-ROMs on short notice for permanent record storage or a preliminary software release, you had to go to an outside CD mastering and replication facility—adding cost, time, as well as security risks to the process.

Now, desktop CD-ROM recorders are starting to reach a price point where companies can afford to create and distribute a few CD-ROM disks in-house. Philips Consumer Electronics Co. (800-835-3506), for example, sells its CDD-521CW compact disk recorder with SCSI adapter and DOS recording software for only $7,995. JVC's Personal RomMaker for DOS (714-965-2610) includes a 680MB hard drive and software, and costs $12,799. Sony Corp. of America's (800-352-7669) CDW900E recorder sells for $11,999. Some recorders can serve double duty as playback devices, but not all recorders can play back all standard CD-ROM disks.

Blank CD-R (CD-Recordable) disks are available for less than $40 (from any of the companies selling recorders), and a single 600MB recording can be made in less than an hour. Depending on the recorder, disks will hold from 540MB to 630MB of data.

HOW THEY WORK

A CD-ROM player works by reading the reflected light from a small laser as it follows the pits and lands of the spiral track in a compact disk. Standard 5-inch CD-ROM disks have three layers: A polycarbonate substrate with the spiral track that contains pits, a thin reflective layer that covers the substrate, and a protective plastic coating. The pits are detected by an optical receptor that measures the reflected laser light and then converts the values into digital information.

MAKING TRACKS

To create the pitted spiral track, CD-ROM recorders require a high-power laser, additional firmware, and special disks. Blank CD-Rs have a plain, unpitted spiral track stamped into a polycarbonate base. Laid down on top of the substrate is an extra layer of sensitive organic dye (often green). On top of the dye layer is a reflective layer of gold, and, as with standard CDs, the disk is covered in a protective plastic layer.

To write to a blank disk, the CD recorder uses the high-power laser to heat up the various layers. The different reactions of the three layers causes pits to form. Once recorded, the CD-Rs can be played back by the low-power laser of a standard CD-ROM player without fear of erasing the information.

CD-R disks may also contain extra data not found on standard CD-ROMs. Often there is one or more tables that indicate the start or stop points of recorded material and a program calibration section that contains information about the amount of laser energy that is needed to make recordings on a particular disk.

SOME LIMITATIONS

There are limitations to the recording approach that is currently in use, however. Because of the relative lack of stability of the dye and substrate system, for instance, you cannot write over previously recorded portions of a disk.

Furthermore, CD-ROM recordings must be made in single pass (or single-session mode) in order for the

CONTINUES

Desktop Recorders

CONTINUED

information to be recognized by current CD-ROM players. If you record 200MB of data on a disk and later decide that you need to add another 100MB of information—a so-called "multisession" recording—a standard CD-ROM player will not recognize all the data. Primarily, that's because the current ISO 9660 CD-ROM standard does not make allowances for more than one table of contents on a CD-ROM disk. Most recorders are able to handle multisession material, however.

As of this writing, discussions are underway by the Frankfurt Group (which includes Philips and Sony, among others) to create a multisession CD-ROM standard. It is unlikely, however, that most CD-ROM players currently in PCs will be upgradable to accommodate multisession CD-Rs.

If you're considering a CD-ROM recorder for applications such as archival backup and CD-ROM publishing, you should also understand that CD-ROM recorders are not standard DOS storage devices. You cannot write to a disk using DOS's XCOPY or COPY commands, for example. In addition, you cannot rename a file once it has been written to the CD. Therefore, you need to use the vendor's software, which may or may not be suitable for your purposes.

An additional restriction of all CD-ROM recording software that uses Microsoft's MS-DOS CD-ROM Extensions (MSCDEX) is that certain filenames will not be recognized. This is because the CD-ROM extensions—intended originally only for standard CD-ROM players—conform to the ISO 9660 file conventions. Consequently, only file names that are alphanumeric (plus underlines) are recognized. This limits archival storage use, since many word processing files, for example, contain tildes.

MORE THAN CD-ROM

If these restrictions don't dissuade you, you might also consider third-party packages that allow you to record more than just CD-ROM disks. Most CD-ROM recorders, such as the Philips CDD-521CW and Sony's CDW900E, are capable of recording other CD formats, including CD audio (Red Book), CD-ROM XA (Extended Architecture), CD-I (CD-Interactive, known also as the Green Book), and Photo CD. Additional software and hardware is required, however.

Making CD-ROMs is still a relatively expensive proposition, so don't expect to see home CD-ROM recorders any time soon.

Currently, several vendors offer packages for these formats based on CD-ROM recorders from JVC, Philips, Sony, and Yamaha. Dataware Technologies Inc. (800-344-5849), Optical Media International (800-347-2664), and OptImage Interactive Services Co. (800-234-5484) sell a variety of hardware and software solutions. Meridian Data Inc. (408-438-3100) will have an offering available in December. How much you'll have to spend will depend on the formats you want to support; prices for complete packages range from about $9,000 to $27,000.

Making CD-ROMs and recordings in other CD formats is still a relatively expensive proposition, so don't expect to see home recorders any time soon. Furthermore, other optical technologies, such as magneto-optical drives, are faster, rewritable, and less expensive. But if you need to create limited numbers of CD-ROM titles for databases and limited distribution, a CD-ROM recorder may now be within your means. □

(KBps). As would be expected, running the Liberty drive through the parallel-port adapter (which we also received for testing) produced less than half of the throughput as through the direct SCSI connection.

The 380-ms (milliseconds) average access time is on the slow side compared with some of the other units tested. The system revealed perceptibly slower access of text and images, even when compared with other drives with similar access times. Although the product provides a 64K buffer and motion video clips were continuous, there was some barely perceptible hesitation that lent an impression of jerkiness to the motion. Audio quality was good, however.

That small jerkiness in full-motion video marred otherwise solid performance, but not enough to remove this decently (if not modestly) priced unit from consideration. Liberty offers basic service and support, with the standard one-year warranty on parts and labor. But

FACT FILE

Liberty 115 Series CD-ROM

Liberty Systems Inc., 160 Saratoga Ave., #38, Santa Clara, CA 95051; 408-983-1127; fax, 408-243-2885

List price: With cables and caddy, $699; ISA SCSI adapter kit with audio CD software, $89; parallel-port adapter kit with audio CD software, $100; MCA interface kit, $259; soft carrying case, $29; Macintosh kit, $40

Requires: 29K RAM, DOS 3.0 or later.

In short: The Liberty 115 Series CD-ROM is small and light enough to travel and can run through an optional parallel-port adapter; a battery option would add to its appeal for users in the field. Some jerkiness in motion video is a bit of a disadvantage, but it wasn't severe enough to remove this drive from consideration. The base mechanism is a Sony CDU-541.

462 ON READER SERVICE CARD

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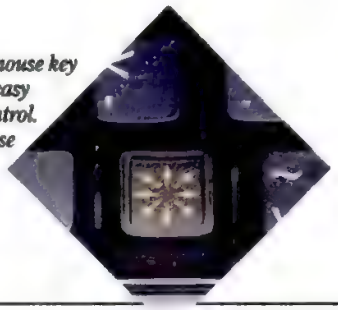

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Folded edge of the page

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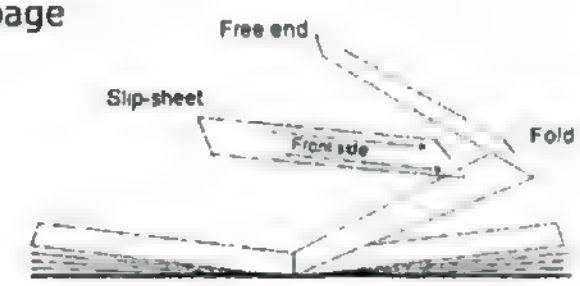
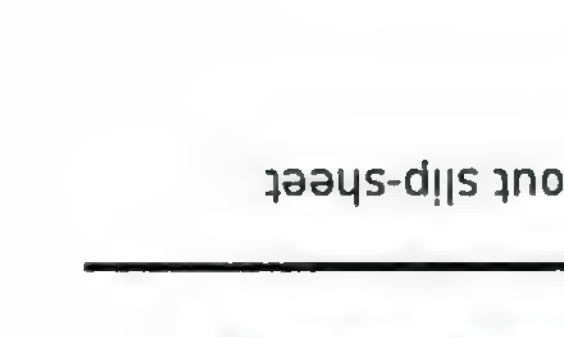
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



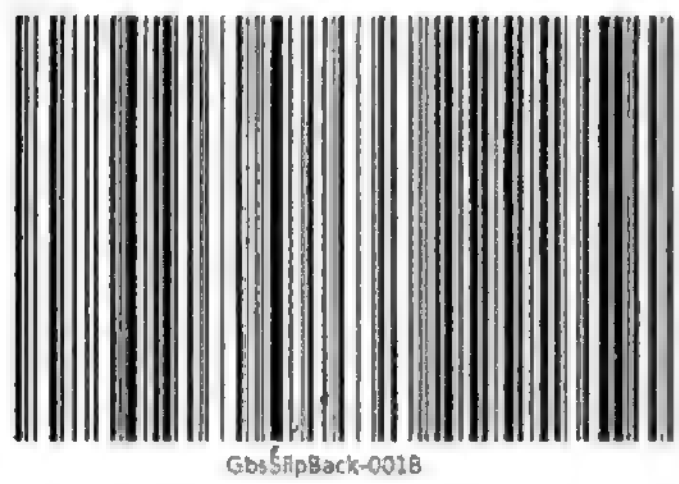
Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



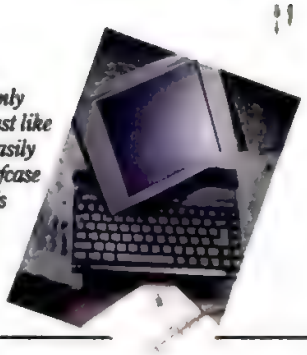
Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side



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technical support will cost you for the call, and there is no BBS support available for the unit.

Among the Liberty offering's advantages for users on the go are its ability to operate using the PC's parallel port via the optional parallel-port adapter, as well as its light weight. Liberty would do well to consider adding a battery option to enhance this system's appeal for operation in the field.

MacProducts USA Inc.

MacProducts Magic CDR74
MacProducts Magic 3301 Toshiba

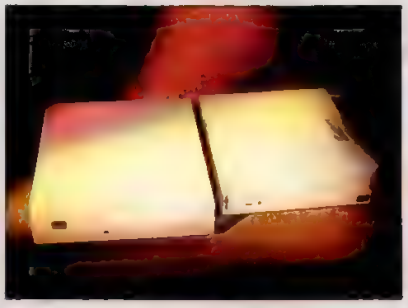
BY PATRICK HONAN

MacProducts USA's $699 Magic CDR74 will appeal to speed lovers: With a 300-KBps (kilobytes per second) transfer rate, this CD-ROM drive naturally performs significantly faster than its 150-KBps competitors, including the $549 MacProducts Magic 3301 Toshiba. The Magic 3301 is aimed at the economy minded: This unit costs less than most of the drives in this roundup, even with the additional $149 8-bit Trantor Systems SCSI board (sold by MacProducts for use with both Magic drives).

MacProducts acquires and relabels the Magic CDR74 from NEC Technologies. MacProducts' drive is almost identical to the 280-ms (milliseconds) NEC InterSect CDR-74 ($725) also reviewed in this issue. The main difference between these two 300-KBps drives is their list prices. Without an interface, the Magic CDR74's list price is slightly lower than that of the NEC CDR-74; adding the SCSI board, however, makes the Magic CDR74 $34 more than a comparably configured NEC CDR-74. And since MacProducts sells direct (it is a mostly Macintosh-oriented mail-order company), you should not expect the price discounting you'll find for the NEC version.

The Magic 3301 houses a 325-ms Toshiba TX3301 mechanism. Both MacProducts packages use the Trantor drivers and have a 64K buffer. An MCA version of the Trantor SCSI board costs $199. Both MacProducts drives have a similar list of features and case design, including a self-cleaning lens. Each unit has a drive-access light, headphone jack, and volume control knob on the front; RCA jacks on the back provide connection to a stereo system. The Magic 3301 is slightly smaller and has its power switch on the back of the case, while the Magic CDR74 has the power switch on the front.

The Magic CDR74 supports Kodak's single-session Photo CD format, and will eventually be able to become CD-ROM XA-compatible with an adapter or firmware upgrade (though the needed upgrade hardware is not yet available).



FACT FILE

MacProducts Magic CDR74

List price: With cables and caddy, $699, Magic CDR74 internal drive, $599, ISA SCSI adapter kit, $149; MCA SCSI adapter kit, $199

Requires: 13K RAM, DOS 3.0 or later

MacProducts Magic 3301 Toshiba

List price: With cables and caddy, $549, Magic 3301 Toshiba internal drive, $449, ISA SCSI adapter kit, $149; MCA SCSI adapter kit, $199

Requires: 20K RAM, DOS 3.0 or later

In short: With the Magic CDR74 and Magic 3301, MacProducts USA offers two solid entries, one for speed lovers and one for the economy-minded. The Magic CDR74 (based on the NEC CDR-74 mechanism) costs more than the Magic 3301 (based on a Toshiba TX3301 mechanism), but the Magic CDR74 is one of a growing number of double-speed drives that operate at a 300-KBps transfer rate. It offers significantly faster performance than the Magic 3301 and other 150-KBps drives, but it faces tough competition from the NEC version

MacProducts USA Inc., 608 W. 22nd St., Austin, TX 78705; 800-622-3475, 512-472-8881; fax, 512-499-0888

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PERFORMANCE

The Magic CDR74 and Magic 3301 performed within the range of the other CD-ROM drives in their respective transfer-rate categories. Informal tests underscored the differences in performance between the two drives, with the Magic CDR74 taking advantage of its 300-KBps throughput rating and faster access time. The Magic CDR74 was visibly faster and more responsive than the Magic 3301 when performing standard tasks—such as executing menu selections and redrawing screens—within the CD-ROM-based encyclopedia we employed for the informal testing.

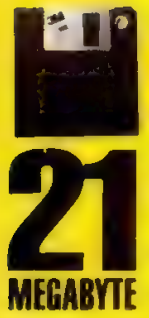
BETTER DOCS NEEDED

Both of these drives suffered from one glaring omission: documentation. A MacProducts spokesperson explained that these CD-ROM drives were new to MacProducts and that the company was in the process of creating manuals for them. The new manuals should be available by the time you read this, but until they are, the only documentation supplied to customers comes from Trantor Systems for the driver software and SCSI board.

Fortunately, both drives installed easily and the included Trantor manuals adequately covered information about jumper settings, addresses, and interrupts. The software installs automatically, stopping along the way only to ask the user several setup questions. Automatic updates to AUTOEXEC.BAT and CONFIG.SYS files are accomplished without fuss. Both drives ran without a hitch using the default installation settings, and the entire process took about five minutes per drive for hardware and software installation.

The Magic CDR74 has a two-year warranty, while the Magic 3301 is covered for only one year. Half-height internal versions of the Magic CDR74 and Magic 3301 drives are available for $599 and $449, respectively. MacProducts provides technical support on the drives, but it is not a toll-free call.

Both MacProducts drives offer good value within their speed classes. If money isn't your primary concern, the Magic CDR74's faster speed and longer warranty makes it the better choice of the two. But with the same length warranty *and* toll-free technical support, the NEC CDR-74 offers a cost-competitive alternative to the Magic CDR74 double-speed version.



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- Mass Micro
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- Rancho Technologies
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NEC Technologies Inc.

NEC InterSect CDR-37
NEC InterSect CDR-74

BY JOHN R. QUAIN

NEC Technologies was the first manufacturer to introduce a double-speed CD-ROM drive, and also one of the earliest players in the portable CD-ROM arena. Though other companies now offer both double-speed drives and inexpensive low-end models, the two NEC CD-ROM units we tested—the $725 double-speed InterSect CDR-74 and the $499 portable InterSect CDR-37—prove that NEC is still able to compete at both ends of the CD-ROM spectrum.

TWICE AS FAST

On PC Magazine Labs' tests, the pioneering double-speed CDR-74 delivered about twice the sustained data-transfer rate of standard 150-KBps drives and compared favorably with the other 300-KBps drives in its class. To achieve this performance, the CDR-74 spins and decodes CD-ROM disks that contain text, graphics, and video at twice the standard rate. To play conventional Red Book audio, it drops down to the standard 150 KBps. The drive also has a 64K buffer and a 280-ms rated average access time—versus the 325-ms to 380-ms access time typical of many CD-ROM players.

Combining performance with practicality, the CDR-74 uses a double door and a self-cleaning lens to combat dust. The external CDR-74 also has a disk-caddy design and a front-panel headphone jack with volume control. On the back, there are two SCSI connections and stereo audio output jacks. (An internal half-height version of the drive, the CDR-84, is available for $649.) The CDR-74 is also available as part of a $999 package with an NEC SCSI/audio sound board, speakers, headphones, and six software titles.

Compared with the other 300-KBps drives in this roundup, NEC's CDR-74 is competitively priced. Its list price is slightly more expensive than that of the Texel DM-5024 ($699 including SCSI interface); with the 8-bit, $89 SCSI adapter received for testing, the cost of the NEC package is $814. Texel sells only directly though, and the $600 street price of the NEC drive (sans adapter) hovers at around the same you would pay for the Texel unit without its SCSI adapter. (An MCA interface kit and parallel-port adapter, which we didn't test, are available for $149 and $112, respectively.)

MacProducts resells an identical version of the NEC drive (which is also reviewed here). Though MacProducts' $699 price tag for its Magic CDR74 is $26 cheaper than NEC's list price for the drive, MacProducts doesn't offer any dealer discounts and charges $60 more than NEC for an interface kit.

FACT FILE

NEC InterSect CDR-37

List price: With cables and AC adapter, $499; ISA SCSI adapter kit with earphones and DOS Musicbox audio CD software, $89; MCA interface kit, $149; parallel-port adapter kit, $112; Macintosh interface kit, $37; rechargeable nickel cadmium battery, $99

Requires: 10K RAM, DOS 3.1 or later

NEC InterSect CDR-74

PC EDITORS' CHOICE

List price: With cables, caddy, and DOS Musicbox audio CD software, $725; CDR-84 internal drive, $649; ISA SCSI adapter kit, $89; MCA interface kit, $149; parallel-port adapter kit, $112; Macintosh interface kit, $37; Multimedia Upgrade kit with audio board, Windows 3.1 on CD-ROM, amplified speakers, headphones, microphone, cabling, $489

Requires: 10K RAM, DOS 3.1 or later

In short: Two strong offerings from NEC compete at opposite ends of the CD-ROM market. The CDR-74 is the first double-speed player, and though others have entered the 300-KBps fray, the NEC drive holds it own. For travellers, NEC offers the CDR-37, a slower but more portable model

NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191-1094; 800-632-4636, 708-860-9500; fax, 800-366-0476

464 ON READER SERVICE CARD

PORTABLE CDR-37

For users who need portability rather than maximum performance, NEC offers the InterSect CDR-37 (available for between $399 and $440 on the street). Designed like a conventional audio CD player, this model doesn't require a disk caddy. With its flip-up top, it resembles a portable CD audio player, albeit heavier (2.2 pounds) and bulkier (1.7 by 5.6 by 8.7 inches). But the unit is lighter and smaller than the other portable CD-ROM players with battery options in this review. It comes standard with connecting cables and an AC adapter.

Supporting standard CD-ROM formats and Red Book audio, the CDR-37 has a 64K buffer and a rated 450-ms average access time—one of the slower rated drives in our roundup. Data-transfer rates, however, were well within the 150-KBps range required of CD-ROM players for multimedia work. Overall in PC Labs' tests, the CDR-37 performed as well as other CD-ROM players when connected via its 8-bit SCSI interface.

For audio output, the CDR-37 provides a mini headphone jack, but there are no stereo RCA jacks to drive speakers or an audio card. When turned up to full volume, there is some noticeable distortion through the headphones, though it's an improvement over the previous model, the CDR-36.

If you plan to travel, NEC's optional rechargeable nickel cadmium battery will set you back $99 and add about a pound to your luggage. It takes approximately 15 hours to recharge the battery but only about an hour and a half to deplete it. Travelers should also consider the optional parallel-to-SCSI external adapter for $112. Used for connecting the drive to a PC's parallel port, the adapter (which we didn't see for testing) is particularly handy for laptops that can't accept an interface card.

For standard ISA PCs, both NEC drives were tested using the company's $89 8-bit Trantor Systems T128 SCSI interface. The interface package for the CDR-37 includes earphones, installation software, and the DOS Musicbox utility for playing audio CDs (that utility comes standard with the CDR-74 drive). Both models are also "CD-ROM XA ready," meaning both can be upgraded with an adapter or firmware (although the com-

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Floppy Disk Support	✓	✓	✓
Integral Disk Cache	✓		✓
Automount	✓	✓	
Menu-Driven Interface	✓	✓	
Universal Data Exchange (UDE™)	✓	✓	
Consolidate	✓	✓	
Recompress	✓	✓	
Data & Image Compression for Windows	NEW!		
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pany has not yet decided upon an upgrade path). They also support Kodak's single-session Photo CD specifications.

Both NEC offerings held up well under critical evaluation, delivering steady performance for a reasonable price. NEC adds additional luster to these products by including toll-free technical help and a two-year warranty on parts and labor.

Philips Consumer Electronics Co.

Philips CM-205XRS

BY JOHN R. QUAIN

Based on a package from its Laser Magnetic Storage International Co. (LMS) subsidiary, Philips Consumer Electronics' CM-205XRS CD-ROM player ($599) is the internal sister of the external LMS CM225 ($630) reviewed in this roundup. To attract customers to its model, Philips adds something besides the brand name recognition: two software CD-ROM disks and toll-free technical support.

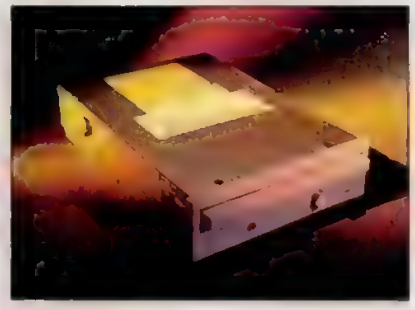
Physically, the Philips CM-205XRS has the same basic features as the LMS CM225—as do the Procom PXCDL and Tandy CDR-1100 drives, which those companies also acquire from LMS. The Philips CM-205XRS fits snugly in a half-height drive bay, uses a disk tray instead of a caddy, and comes with a proprietary LMS 8-bit host adapter.

Like the others, it supports common CD-ROM formats and Red Book audio disks. As with the Tandy internal package, the RCA jacks on the Philips are located on the interface card. For CD-ROM XA support, Philips offers a $499 CDD167XA interface with 32K of memory and audio outputs.

Performance differences between the four LMS-based drives were within PC Magazine Labs' testing margin of error, confirming the fact that no matter which package you chose, all four models will deliver similar, up-to-par speed. Moreover, with the exception of the Tandy model that encountered problems playing motion video, each suffered and benefited from the same set of features, such as minimum audio distortion and a caddyless design that affords convenience, but not maximum dust protection.

To differentiate itself from the others, Philips bundles the CM-205XRS with two strong CD-ROM titles: the New Grolier Electronic Encyclopedia and the PC-SIG Library on CD-ROM. The latter disk boasts hundreds of DOS shareware titles ranging from utilities and spreadsheet templates to games and trivia puzzles.

At $395 and $399.95, respectively, the external Procom PXCDL and internal Tandy CDR-1100 are less expensive than the Philips internal unit, and Procom bundles in four software titles for only $150 more. But that doesn't mean the Philips drive doesn't deserve a place on your list, particularly if you can find a good bargain on the street.



FACT FILE

Philips CM-205XRS

Philips Consumer Electronics Co., One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-835-3506; fax, 310-217-1883

List price: With proprietary adapter, cables, two CD ROM titles, $599

Requires: 32K RAM, DOS 3.0 or later

In short: By bundling a CD-ROM player from its Laser Magnetic Storage subsidiary with two software titles, Philips works to attract buyers to the internal CM-205XRS. While there's little in terms of performance or handling to separate it from the rest of the models based on the LMS-205 mechanism, the Philips drive presents quite an acceptable package, particularly if you can get a good bargain on the street.

465 ON READER SERVICE CARD

PLI

PLI CD-ROM Drive

BY HENRY FERSKO-WEISS

With smooth motion video and SCSI 2 support, PLI's sturdy PLI CD-ROM Drive ($699) makes an attractive offering. The unit serves best as a desktop device hooked up via its $89 8-bit or $199 16-bit SCSI adapter, although the company does offer options for on-the-road users, including a somewhat pricey $199 parallel-port adapter (which we didn't see for testing) and a $99 soft carrying case.

But even though PLI's drive uses the same Sony CDU-541 mechanism as the more portable Liberty 115 Series unit we review here, the PLI's casing brings this drive's weight to 6.2 pounds and its footprint to 9.8 by 9.8 inches. With this extra bulk and no battery option, the PLI drive isn't the wisest in-the-field choice for anyone but the occasional traveler.

On the street, the PLI CD-ROM by itself sells for close to $595. An internal version of the drive, the half-height PLI CD-ROM Drive Internal, lists for $599 without an adapter.

As with the Liberty 115 and the Procom SXCDS units reviewed here, the PLI system is based on a Sony CDU-541 mechanism with a somewhat slow 380-ms (milliseconds) average access rating. PLI manufactures the 16-bit ISA SCSI adapter we saw for testing using a Future Domain chip set. (An MCA interface kit costs $265.) The driver software comes from Future Domain.

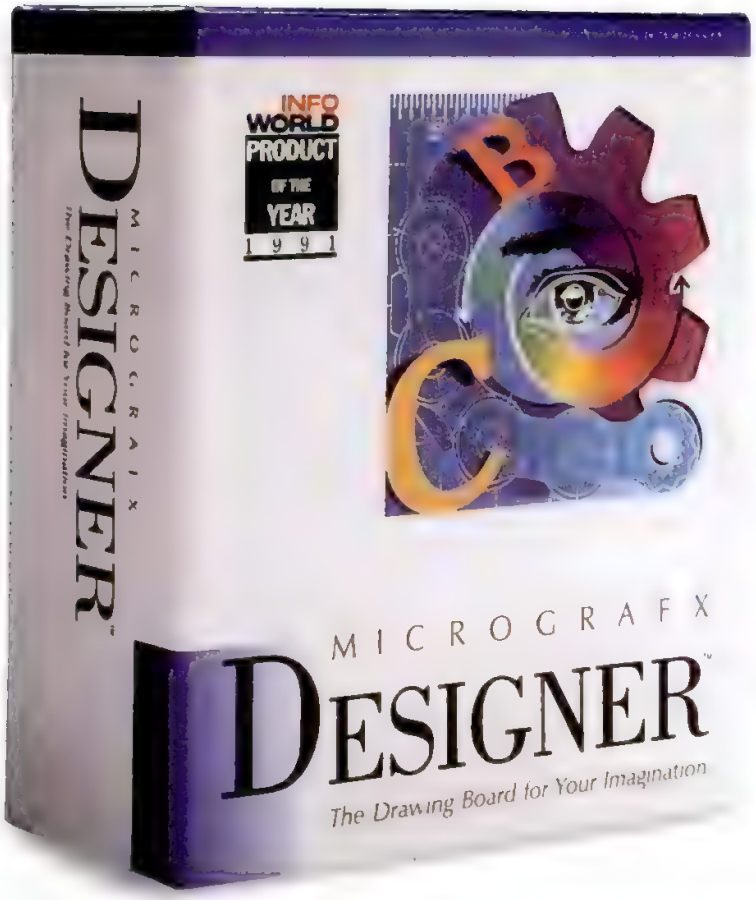
Installing the PLI drive is straightforward enough—especially if you ignore the three overly technical manuals that come with it. The jumper factory settings and dip switches worked right out of the box on our test configuration. The automatic software installation works without problems.

PERFORMANCE

On the PC Magazine Labs' Sequential Throughput test, the PLI unit, when used with its 16-bit SCSI adapter, performed about the same as the rest of the group. You can probably expect half the performance with the parallel-port adapter option. In operation, the drive seemed particularly responsive, without some of the jerkiness that distorted some other products' performance. In terms of audio output, there was only the slightest evidence of background noise.

The design suffers a few minor drawbacks, however, such as a short 21-inch interface cable and the lack of a power indicator. A self-cleaning lens does help protect against dust buildup, however.

The service and support offered



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Designer system requirements: 286 (386 recommended) IBM PC or compatible, or PS/2, 1 MB RAM (2 MB RAM recommended), 20 MB (or larger) hard disk, Windows 3.0, DOS 3.1 (or higher), Mouse or digitizing pad, Windows-compatible monitor.

FACT FILE

PLI CD-ROM Drive

PLI, 47421 Bayside Pkwy., Fremont, CA 94538; 800-288-8754, 510-657-2211; fax, 510-683-9713

List price: With cables and caddy, $699; PLI CD-ROM Drive Internal, $599; 8-bit ISA SCSI adapter kit, $89; 16-bit ISA SCSI adapter kit, $199; parallel-port adapter kit, $199; MCA SCSI adapter kit, $265; soft carrying case, $99.

Requires: 19K RAM, DOS 3.0 or later.

In short: The battery-less PLI CD-ROM is too large and heavy to be considered a true portable, although you can operate it through an optional parallel-port adapter. But smooth performance and good support options make this drive, based on a Sony CDU-541 mechanism, a worthwhile choice for most desktop users and anyone who isn't constantly on the road.

466 ON READER SERVICE CARD

through Peripheral Land is better than many companies provide. Added to the standard one year parts-and-labor warranty is a 30-day money-back guarantee, toll-free technical support, and a 24-hour BBS. You can extend the service contract for up to three years at an annual cost of 10 percent of the purchase price.

If you're looking for a drive that delivers smooth performance and good support options, the PLI CD-ROM Drive should be on your list.

Procom Technology Inc.

Procom PXCDL
Procom SXCDS-C8

BY JOSEPH DESPOSITO

With respective list prices of $395 and $765, the Procom PXCDL and the Procom SXCDS-C8, from Procom Technology Inc., are attractively priced offerings. Options to bundle four CD-ROM software packages with each drive for only $150 more further enhance the appeal of these products.

Street prices for the external models save you an additional 5 percent or so. You'll spend even less money on the half-height internal versions of the drives: The PICDL lists for $325 and the SICDS costs $565.

As with the internal Philips and Tandy drives in this review, the PXCDL external drive is based on the LMS CM205 drive mechanism, from Laser Magnetic Storage International. Procom manufactures the interface card itself, but it is based on the same LMS 8-bit proprietary interface technology. Procom also writes its own device drivers. The SXCDS-C8 relies on a 380-ms (milliseconds) Sony CDU-541 drive mechanism and Procom's own 8-bit SCSI interface. The SXCDS-C8 supports Kodak's single-session Photo CD format.

On the PC Magazine Labs Sequential Throughput test, both external drives delivered results comparable with the rest of the group of 150-KBps (kilobytes per second) units. Both drives played motion video without problem and generated satisfactory audio.

Both units have two audio sources: a headphone jack at the front and RCA jacks at the rear. The PXCDL doesn't use a caddy, so it can be particularly prone to dust build-up. While the SXCDS-C8 has a caddy, it lacks any additional protection against dust, such as a sealed enclosure or double doors, although it has a self-cleaning lens.

Four CD-ROM disks are options with each drive: the Software Toolworks Illustrated Encyclopedia, the Software Toolworks U.S. Atlas/The Software Toolworks World Atlas (slightly out of date because it does not include the changes in Germany and the former Soviet Union), the Software Toolworks Reference Library, and the National Geographic Society Educational Services' Mammals: A Multimedia Encyclopedia.

Setting up the PXCDL was delightfully simple. The default settings on the interface card worked immediately, as did the software installation defaults. The SCSI-based SXCDS-C8 derives power from the 8-bit CC-Enabler interface card, which includes several jumper wires and a special mini-DIN power connector.

FACT FILE

Procom PXCDL

List price: With proprietary adapter and cables, $395; with above and four CD-ROM titles, $545; PICDL internal drive, $325 (or $495 with four CD-ROM titles).

Requires: 9K RAM, DOS 3.3 or later.

Procom SXCDS-C8

List price: With CC-8 Enabler (8-bit ISA SCSI), cables, caddy, $765; with above and four CD-ROM titles, $915; SICDS internal drive, $565; CC-16 Enabler (16-bit ISA SCSI), $349; MC Enabler (SCSI), $349; SXCDS-MC Microchannel version, $855 (or $995 with four CD-ROM titles); Macintosh version (Mac CD/LX), $595.

Requires: 9K RAM, DOS 3.3 or later.

In short: Procom Technology bundles each of its CD-ROM drives with an interface and optionally offers four software titles for a very reasonable cost. The PXCDL (based on the LMS CM-205 mechanism) has some advantages over the SXCDS (based on the Sony CDU-541 mechansm), including a lower price and an easier installation procedure. But the SXCDS's SCSI interface may appeal more to some users.

Procom Technology Inc., 2181 Dupont Dr., Irvine, CA 92715; 800-800-8600, 714-852-1000; fax, 714-852-1221

467 ON READER SERVICE CARD

This unusual setup demands an extra cable to connect the drive to the interface card. Procom also sells a 16-bit CC-16 Enabler for $349, and a MicroChannel MC-Enabler for $349. By the time you read this, Procom should be shipping a new high-performance adapter, the ISA/SCSI Xelerator.

Installing the SXCDS-C8 drive posed a couple of problems because of an 8K ROM on the interface board, which occupied the same 8K block that the EMM driver wanted to use. First, the CD-ROM drive caused the system to boot from the floppy drive until an expanded memory manager statement was removed from the hard disk's CONFIG.SYS file. Then

Double Speed

Drives that maintain a 300 KBps sustained data throughput rate spin the disk at twice the speed of CD-ROM drives with 150KBps transfer rates.

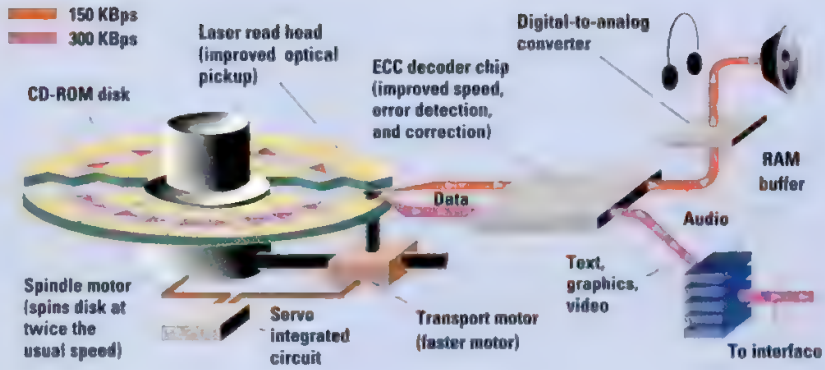
To supplement the higher rotation speed, some vendors have speeded up the transport motor (which moves the read head across the disk to locate desired information) to work in sync with the faster spindle motor. Another technique is to improve the performance of the servo system to allow the drive to switch back and forth—in less than a second, if necessary—from the minimum 200 revolutions per minute on inner tracks (for audio) to the maximum 1,060 rpm on outer tracks.

To preserve data integrity at the higher rotation speeds, vendors have improved error detection and correction circuitry and algorithms to manage the increased amount of data.

As a result, doubling the number of revolutions per minute decreases the average *latency* (the amount of time it takes for a chosen sector to make one full revolution). The result is faster access times: These four drives had access times of under 300 milliseconds (ms).

At their highest throughput, these drives transfer text, graphics, and video with the disk spinning at a speedy 400 rpm to 1,060 rpm, depending on where the data is stored. To play conventional Red Book audio, data is transferred with the disk rotating at the slower speeds of 200 rpm to 530 rpm (again, depending on the position of the data).

The reduction in throughput—to 150 KBps—for CD audio is necessary because conventional audio is streaming, real-time data. CD audio is routed directly to a digital-to-analog (D/A) converter and then to an audio output source—headphone jack, RCA jacks, or a sound card. In contrast, text, graphics, video, and waveform data are transferred to the CD-ROM drive's buffer and then to the computer for processing.—*Joseph Desposito*



Microsoft Windows 3.1 would not work properly until an EMMEXCLUDE statement was added to the SYSTEM.INI file. After these problems were resolved, however, everything worked as expected. Unfortunately, the installation guide had no troubleshooting advice for these problems.

Both Procom drives let you take the plunge for a good price, and with a nicely configured optional software bundle. The lack of any performance difference between the two drives and the ease with which the PXCDL installs (not to mention its lower price) make that unit a very tempting selection for users who don't require a SCSI interface.

Sony Corp. of America

Sony CDU-31A-02
Sony CDU-7211

BY JOHN R. QUAIN

Sony is one of the preeminent names in the CD business, but the company's two CD-ROM players reviewed here face tough competition from other entries.

The Sony CDU-31A-02 unit is a low-end internal drive that suffers from slow disk access speeds, while the Sony CD-7211 drive is a quicker external model that displayed some problems with audio volume and distortion. Both models are solid enough, if not particularly exciting, offerings.

ENTRY-LEVEL SONY CDU-31A-02

Intended for first-time users, Sony's CDU-31A-02 is an internal CD-ROM player that offers the convenience—and susceptibility to dust—of a disk tray rather than a caddy to hold CD-ROM disks. The player itself costs $378, and you'll need an additional $109 for the PC interface kit.

The interface kit comes with a proprietary 8-bit Sony host adapter, connecting cables, installation software, and drivers. The proprietary card includes a stereo audio output jack for connecting self-powered speakers and a 50-pin connection for hooking up external Sony CD-ROM drives (up to four). Audio frequency response for the CDU-31A-02 is rated at 100 Hz to 20 KHz, so low bass passages in music lack some depth.

A standard 150-KBps (kilobytes per second) internal CD-ROM player with a 64K buffer, the CDU-31A-02's rather tardy 550-ms (milliseconds) rated average access time was apparent in hands-on testing. Though PC Magazine Labs' Sequential Throughput tests demonstrated that the CDU-31A-02 can handle multimedia tasks, most users will notice the slower performance when initially accessing CD-ROM disks. In general, this drive demonstrates acceptable abilities, but users looking for top performance will become impatient.

QUICKER SONY CDU-7211

Those who can't wait the additional seconds may consider Sony's external CDU-7211. It boasts a caviar-and-champagne list price of $919.95, plus the cost of a $160 interface kit to complete the package (street price for the package is a more palatable $620). On PC Labs' Sequential Throughput test, the CDU-7211 held its own among the standard drives, but of course produced only half the throughput of the double-speed models we looked at.

Features of the Sony disk caddy–based CDU-7211 include a 64K buffer,

▶ SUMMARY OF FEATURES

CD-ROM Drives

Products listed in alphabetical order
■ = YES □ = NO

	CD Porta-Drive Model T3301	Chinon CDC-435	Hitachi CDR-3700	Hitachi CDR-3750	LMS CM225	Liberty 115 Series CD-ROM
List price (tested configuration)	$995.00	$895.00	$865.00	$1,045.00	$630.00	$788.00 (SCSI interface), $799.00 (parallel-port interface)
Physical Characteristics						
Mechanism model	Toshiba TX3301	Chinon 435	Hitachi CDR-3700	Hitachi CDR-3750	LMS CM-205	Sony CDU-541
External/internal version available	■■	■■	□■	□■	■■	■/□
External case:						
Dimensions (HWD, in inches)	2.0 x 6.0 x 9.6	2.4 x 6.1 x 10.0	N/A	N/A	2.5 x 9.8 x 10.5	1.9 x 6.8 x 9.6
Weight (pounds)	3.0	5.5	N/A	N/A	6.5	4.5
Length of supplied interface cable	2 ft.	5 ft.	N/A	N/A	3 ft.	2 ft.
Switchable voltage (110/220)	■	□	N/A	N/A	■	■
Caddy manufacturer	CD Technology	Sony	Info not available	Info not available	N/A	Sony
Operating Features						
Power/busy indicators	■■	■■	■■	■■	■■	■■
Operates vertically	■	■	■	■	□	■
Audio (drive or interface):						
Headphone jack	■	■	■	■	■	■
RCA jacks	■	■	□	□	■	■
Volume knob	■	■	■	■	■	■
Performance Ratings						
Buffer size	64K	64K	64K	64K	32K	64K
Average access time	325 ms	350 ms	300 ms	300 ms	375 ms	380 ms
Data transfer rate:						
Average or sustained	150 KBps	150 KBps	150 KBps	150 KBps	150 KBps	150 KBps
Burst	1,500 KBps	2,200 KBps	1,270 KBps	1,270 KBps	2,000 KBps	1,500 KBps
Average latency:						
Inner	60 ms	70 ms	56 ms	56 ms	60 ms	60 ms
Outer	150 ms	150 ms	150 ms	150 ms	155 ms	155 ms
Mean time between failures (hours)	50,000	25,000	50,000	50,000	15,000	25,000
Controller Characteristics						
Controller manufacturer	Future Domain	Chinon	Hitachi	Future Domain	LMS	Trantor
Tested ISA interface	SCSI II	SCSI	Proprietary	SCSI II	Proprietary	SCSI, parallel-to-SCSI
Type	8-bit	16-bit	8-bit	8-bit	8-bit	8-bit
IRQs supported	3, 5	None	None	3, 5	3–6	3, 5, 7
Number of selectable addresses	6	16	8	6	4	4
Maximum number of units in daisy chain	7	7	8	8	N/A	7
Alternate interfaces:						
MCA	■	■	□	□	■	■
Macintosh	■	■	□	□	□	■
Software						
Device driver supplier	Future Domain	Chinon	Hitachi	Future Domain	LMS	Trantor
Version tested	2.20	3.0	2.2	2.21	1.2	1.46F
Offers OS/2 support	■	□	□	□	□	■
Version of MS-DOS CD-ROM Extensions included	2.2	2.21	2.21	2.21	2.21	2.21
Includes Multimedia Extensions for Windows	□	□	□	□	□	■
Customer Support						
Toll-free technical support	□	■	■	■	□	□
Telephone support hours (eastern time)	12:00–8:00 M–F	11:30–8.00 M–F	9:00–5.00 M–F	9:00–5.00 M–F	9:00–7:00 M–F	11:00–8:00 M–F
24-hour BBS	□	■	□	□	□	□
Warranty coverage (parts and labor)	2 years (parts), 1 year (labor)	1 year	2 years	2 years	2 years	1 year

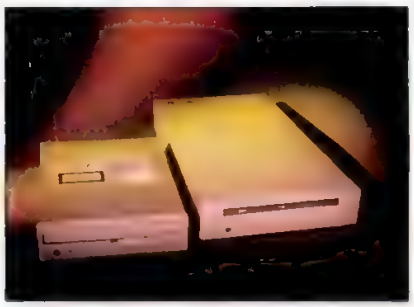
N/A—Not applicable: The product does not have this feature

	MacProducts Magic CDR74	MacProducts Magic 3301 Toshiba	NEC InterSect CDR-37	NEC InterSect CDR-74 (PC Editors' Choice)	Philips CM-205XRS
	$848.00	$698.00	$588.00	$814.00	$599.00
	NEC CDR-74	Toshiba TX3301	NEC CDR-37	NEC CDR-74	LMS CM-205
	■■	■■	■□	■■	□■
	3.0 x 9.0 x 10.0	2.8 x 8.8 x 9.4	1.7 x 5.6 x 8.7	3.0 x 9.0 x 10.0	N/A
	7.7	8.0	2.2	7.7	N/A
	3 ft	3 ft	3 ft.	3 ft.	N/A
	■	■	□	■	N/A
	NEC	Toshiba	N/A	Sony	N/A
	■■	■■	■■	■■	■■
	■	■	□	■	□
	■	■	■	■	■
	■	■	□	■	■
	■	■	■	■	■
	64K	64K	64K	64K	32K
	280 ms	325 ms	450 ms	280 ms	375 ms
	300 KBps	150 KBps	150 KBps	300 KBps	150 KBps
	1,500 KBps	1,500 KBps	1,500 KBps	1,500 KBps	2,000 KBps
	Less than 100 ms	60 ms	Less than 100 ms	Less than 100 ms	60 ms
	Less than 100 ms	150 ms	Less than 100 ms	Less than 100 ms	155 ms
	25,000	30,000	10,000	30,000	15,000
	Trantor SCSI II	Trantor SCSI II	Trantor SCSI	Trantor SCSI	LMS Proprietary
	8-bit	8-bit	8-bit	8-bit	8-bit
	3	3	0–2	0–2	3–6
	4	4	4	4	4
	7	7	7	7	N/A
	■	■	■	■	□
	■	■	■	■	□
	Trantor 4.51B	Trantor 4.51B	Trantor T128	Trantor T128	LMS 1.2
	■	■	□	□	□
	2.21	2.21	2.21	2.21	2.21
	□	□	□	□	□
	□	□	■	■	■
	9:00–6:00 M–F	9:00–6:00 M–F	7:30–6:00 M–F	7:30–6:00 M–F	8:00 A.M.–8:00 P.M. M–F
	■	■	■	■	□
	2 years	1 year	2 years	2 years	2 years

CONTINUES

a 380-ms rated average access time, and a self-cleaning lens. On the front of the CDU-7211, there's a headphone jack with a volume control and an eject button. On its back, there are audio line outputs and two SCSI connections to facilitate daisy-chaining up to seven additional SCSI peripherals. Audio tracks played through the headphone jack did not offer a lot of volume, and there was some detectable distortion when the level was boosted on loud musical passages.

The SCSI-2 interface kit tested with the drive includes an 8-bit Future Domain TMC-850 SCSI card, installation software, drivers, and cables. The software device driver takes about 28K of memory but does not require DMA access or an interrupt. The automated install program worked with the default settings, though like some other drives in this issue, we had to manually insert the



FACT FILE

Sony CDU-31A-02

List price: $378; proprietary adapter kit, $109.
Requires: 9K RAM, DOS 3.0 or later.

Sony CDU-7211

List price: $919.95; ISA SCSI adapter kit with cables, $160; MCA SCSI adapter kit, $300; CDU-541-01 internal drive, $700; ISA SCSI adapter kit for internal version, $150.
Requires: 28K RAM, DOS 3.0 or later.
In short: These commonplace CD-ROM players from Sony, both based on Sony mechanisms, won't raise much customer interest. The entry-level CDU-31A-02 offers convenience but suffers from slow response times, while the CDU-7211 delivers better performance—for a rather steep price.

Sony Corp. of America, Computer Peripherals Products Co., 655 River Oaks Pkwy., San Jose, CA 95134; 800-352-7669, 408-432-0190

ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	PLI CD-ROM Drive	Procom PXCDL	Procom SXCDS-C8	Sony CDU-31A-02	Sony CDU-7211
List price (tested configuration)	$898.00	$545.00	$915.00	$487.00	$1,079.00
Physical Characteristics					
Mechanism model	Sony CDU-541	LMS CM-205	Sony CDU-541	Sony CDU-31A	Sony CDU-7211
External/internal version available	■■	■■	■■	□■	■■
External case:					
Dimensions (HWD, in inches)	2.4 x 9.8 x 9.8	2.1 x 6.2 x 12.5	2.1 x 6.2 x 12.5	N/A	2.0 x 7.1 x 13.3
Weight (pounds)	6.2	3.4	3.9	N/A	6.4
Length of supplied interface cable	1 ft. 9 in.	3 ft. 1.5 in.	6 ft.	N/A	3 ft.
Switchable voltage (110/220)	■	□	□	N/A	■
Caddy manufacturer	Sony	N/A	Sony	N/A	Sony
Operating Features					
Power/busy indicators	□■	□■	□■	□■	□■
Operates vertically	■	■	■	□	■
Audio (drive or interface):					
Headphone jack	■	■	■	■	■
RCA jacks	■	■	■	□	■
Volume knob	■	■	■	■	■
Performance Ratings					
Buffer size	64K	32K	64K	64K	64K
Average access time	380 ms	375 ms	380 ms	550 ms	380 ms
Data transfer rate:					
Average or sustained	150 KBps	150 KBps	150 KBps	150 KBps	150 KBps
Burst	1,500 KBps	2,000 KBps	1,500 KBps	2,100 KBps	1,500 KBps
Average latency:					
Inner	60 ms	60 ms	60 ms	55 ms	55 ms
Outer	155 ms	155 ms	155 ms	130 ms	130 ms
Mean time between failures (hours)	10,000	15,000	10,000	25,000	25,000
Controller Characteristics					
Controller manufacturer	Future Domain/PLI	Procom	Procom	Sony	Future Domain
Tested ISA interface	SCSI II	Proprietary	SCSI II	Proprietary	SCSI II
Type	16-bit	8-bit	8-bit	8-bit	8-bit
IRQs supported	3, 5, 10–12, 14, 15	2–7	2–7	3–6	2
Number of selectable addresses	4	4	4	4	4
Maximum number of units in daisy chain	6	N/A	7	4	7
Alternate interfaces:					
MCA	■	□	■	□	■
Macintosh	■	□	■	□	□
Software					
Device driver supplier	Future Domain	Procom	Procom	Sony	Future Domain
Version tested	2.20	DK0086 v. 1.01	DK0081 v. 1.00	1.21	2.13
Offers OS/2 support	□	□	□	□	■
Version of MS-DOS CD-ROM Extensions included	2.2	2.21	2.21	2.21	2.21
Includes Multimedia Extensions for Windows	■	□	□	□	□
Customer Support					
Toll-free technical support	■	■	■	□	□
Telephone support hours (eastern time)	11:00–8:00 M–F	10:30–7:30 M–F	10:30–7:30 M–F	11:00–8:00 M–F	11:00–8:00 M–F
24-hour BBS	■	■	■	■	■
Warranty coverage (parts and labor)	1 year	1 year	1 year	1 year	1 year

N/A—Not applicable: The product does not have this feature

	Storage Devices SCD-683	Tandy CDR-1100	Texel DM-5024	Todd TCDR 7000	Todd TCDR 7050
	$899.00	$399.95	$699.00	$1,004.00	$1,084.00
	Toshiba XM3301B	LMS CM-205	Texel DM-3024	Hitachi CDR-3700	Hitachi CDR-3750
	■□	□■	■■	■■	■■
	2.0 x 9.0 x 11.0	N/A	2.4 x 9.7 x 11.2	2.2 x 6.0 x 13.5	2.2 x 6.0 x 13.5
	6.0	N/A	6.6	7.9	7.9
	3 ft.	N/A	3 ft.	3 ft. 5.7 in.	3 ft.
	■	N/A	■	□	□
	Toshiba	N/A	Info not available	Ikka	Ikka
	■■	■■	■■	■■	■■
	■	■	■	■	■
	■	■	■	■	■
	□	■	■	□	□
	■	■	■	■	■
	64K	32K	64K	64K	64K
	300 ms	375 ms	265 ms	300 ms	300 ms
	150 KBps	150 KBps	300 KBps	150 KBps	150 KBps
	1,500 KBps	1,367 KBps	1,500 KBps	1,270 KBps	1,270 KBps
	120 ms	60 ms	57 ms	56 ms	56 ms
	350 ms	155 ms	150 ms	150 ms	150 ms
	25,000	50,000	30,000	50,000	50,000
	Storage Devices	LMS	Trantor	Todd	Trantor
	Parallel-to-SCSI	Proprietary	SCSI II	Proprietary	SCSI II
	N/A	8-bit	8-bit	8-bit	16-bit
	None	3–6	3, 5, 7	5, 7	None
	3	4	4	8	4
	7	N/A	7	8	7
	□	□	■	■	■
	□	□	■	□	■
	Freeport Data	LMS	Trantor	Hitachi	Trantor
	2.5	1.2	1.46D	4D	1.30B
	■	□	■	■	■
	2.0	2.21	2.21	2.21	2.21
	■	■	□	□	□
	■	□	■	■	■
	11:00–8:00 M–F	9:30–6:30 M–F	11:30–8:30 M–F	9:00–5:00 M–F	9:00–5:00 M–F
	□	■	□	■	■
	1 year	1 year	1 year	2 years	2 years

ENDS

SETVER.EXE command in CONFIG .SYS to work with DOS 5.0. This step should not be necessary, however, with Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.21, which should be shipping with both the CDU-7211 and the CDU-31A-02 by the time you read this.

An MCA interface kit for the CDU-7211 costs $300; an internal version of the drive, the CDU-541-01, sells for $700 (plus $150 for the SCSI interface).

In addition to being CD-ROM ISO 9660–compatible and Red Book audio CD–compatible, both drives can handle the CD-ROM XA, Kodak Photo CD, and CD-Interactive formats. In hands-on testing, multimedia CD-ROM titles posed no problems for either drive. Nonetheless, the CDU-31A-02's lack of any particular performance benefits and the CDU-7211's problems with audio may keep some buyers away. A better option may be Sony's CDU-561, a double-speed drive that should be available by the time you read this.

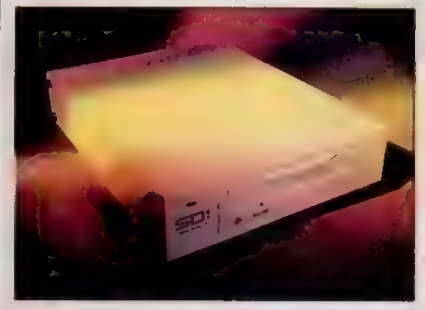
Storage Devices Inc.

Storage Devices SCD-683

BY PATRICK HONAN

Easy to set up and able to connect to a PC's parallel port, Storage Devices's SCD-683 deserves a look from some users who want a portable CD-ROM drive. But there are costs, such as an $899 list price ($750 on the street) for the drive, a disk caddy, cable, installation software, and a set of Freeport Data device drivers. And unlike some other portable CD-ROM drives that also provide direct SCSI connections for faster desktop performance, Storage Devices itself provides only its parallel-to-SCSI connection, which limits speed significantly.

For a portable system, this is no lightweight unit. The SCD-683 has no controller board, since the drive connects to the computer's parallel port. But at 2 by 9 by 11inches (HWD) and 6 pounds, the SCD-683 is as large and heavy as some notebook computers. The optional $100 nickel cadmium battery slides into a chamber along the drive's right side, adds another 2 pounds, and provides operation for 1.5 hours. The unit also needs a 1.5-pound AC adapter (included with the



FACT FILE

Storage Devices SCD-683

Storage Devices Inc., 6800 Orangethorpe Ave., Buena Park, CA 90620; 800-872-7341, 714-562-5500; fax, 714-562-5505

List price: With cables and caddy, $899, rechargeable nickel cadmium battery, $100

Requires: 20K RAM, DOS 3.0 or later

In short: Based on a Toshiba XM3301B mechanism, the SCD-683 is portable and battery-powered, but smaller and lighter portable drives exist. The speed is slow due to the SCD-683's use of a parallel-SCSI connection, and unlike other vendors of portable CD ROM drives, the company itself does not offer a direct SCSI interface or drivers

ON READER SERVICE CARD

battery) for recharging the battery, bringing the total carrying weight to 9.5 pounds. Storage Devices offers no carrying case, but there is a handle on the right side of the drive. There is no internal version available.

There are lighter and smaller portable CD-ROM drives on the market if you plan to travel frequently, such as CD Technology's CD Porta-Drive Model T3301 and the NEC CDR-37 (also reviewed here). Both of these units weigh under four pounds with batttery and AC adapter, although unlike the Storage Devices unit, these two also require extra-cost parallel-port adapters to work via a PC's parallel interface. Even so, at $710 for a package that includes the drive, parallel-port adapter, and battery, the NEC device costs less than the SDI unit.

The SCD-683 is a good choice if your idea of portability is sharing the drive among PCs in the office or toting it home on weekends.

The SCD-683 is a good choice if your idea of portability is sharing the drive among several computers in the office or toting it home on weekends—essentially, if you're not constantly on the road. Simply hook the SCD-683 to the computer's parallel port and install the setup software. The whole process takes about two minutes.

The trade-off of connecting to the parallel port is slower performance than you would get with a direct SCSI connection. (The company reports that the drive can work via a direct SCSI connection, but Storage Devices does not supply the drivers for operating it in this way. You would have to depend on the SCSI board manufacturer for driver support.) The drive, which is itself rated at 150 kilobytes per second (KBps), delivered less than half the throughput of its 150-KBps competitors that used direct SCSI connections; the company claims that it has used the unit at its fastest transfer rate via the parallel-to-SCSI connection.

The SCD-683 features a 300-ms (milliseconds) Toshiba XM3301B drive mechanism, with the volume control, audio headphone jack, and eject button clearly arranged on the front. The power switch is on the back, but there are no RCA jacks. The drive also includes a standard parallel port for connecting to a printer, though of course the CD-ROM drive and printer cannot be in operation at the same time. The SCD-683 ships with both Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.0 (most of the others in this review include Version 2.2 or greater) and Microsoft's Multimedia Extensions for Windows. The unit offers a self-cleaning lens and sealed enclosure. Storage Devices sells a second CD-ROM unit that is identical to the SCD-683 (even in price) except that it uses a Chinon CDS435 drive mechanism.

The SCD-683's ready-to-run portability sets it apart from much of the competition and makes it a good choice for specific situations. But it faces competition from lighter—and in the case of the NEC CDR-37, cheaper—models that offer fast, direct SCSI interfaces for desktop work and optional parallel-port adapters and batteries for field situations.

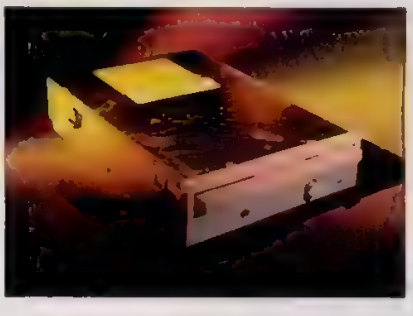
Tandy Corp.

Tandy CDR-1100

BY GREG PASTRICK

Tandy packages Laser Magnetic Storage's 375-ms CM205 drive as the Tandy CDR-1100. It's the CD-ROM drive destined to completely replace the company's own CDR-1000 as a catalog item and key component in the Tandy line of multimedia systems that includes the Tandy 4833 LX/T Multimedia, Tandy 4850 EP Multimedia, and Tandy Sensation.

A low $399.95 investment gets you this drive; the company also bundles it in a $799.95 Multimedia PC Upgrade Kit, which includes an audio adapter with MIDI connector, Microsoft Windows 3.1, Microsoft Windows with Multimedia Extensions, and some sample CD-ROM applications.



FACT FILE

Tandy CDR-1100

Tandy Corp., One Tandy Way, Fort Worth, TX 76102; 817-390-3011

List price: With cables and proprietary adapter, $399.95, Multimedia PC Upgrade Kit (includes drive with audio board, Microsoft Windows 3.1, Microsoft Multimedia Extensions, and sample CD applications), $799.95

Requires: 30 7K RAM, DOS 3.3 or later

In short: The CDR-1100, based on an LMS CM-205 mechanism, replaces the company's own CDR-1000 as a key component in the Tandy line of multimedia systems. The low-cost device is adequate for MPC use, but it has less-than-optimal motion video compared with other drives based on the same mechanism

ON READER SERVICE CARD

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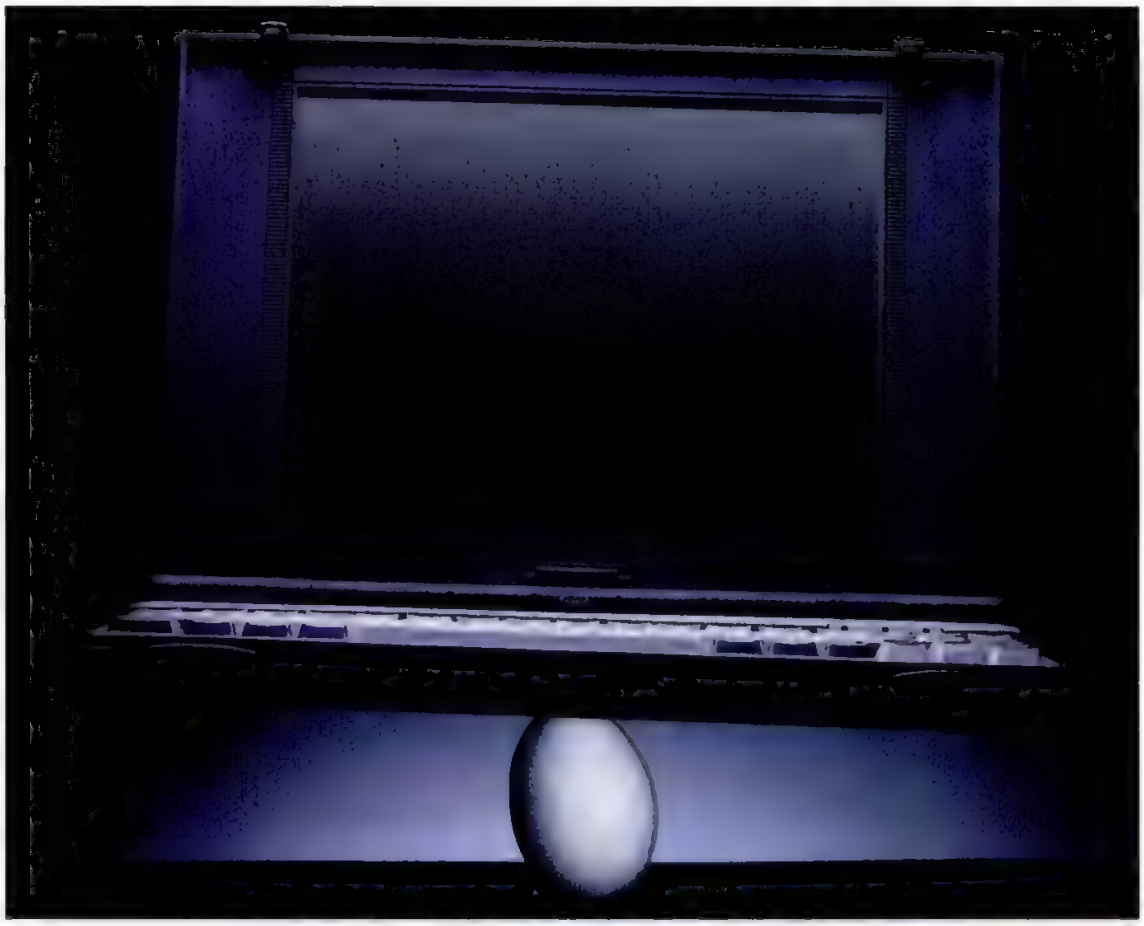

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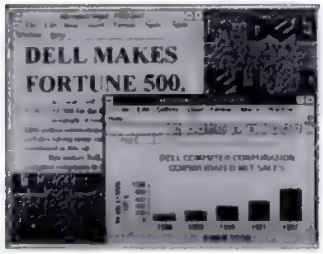

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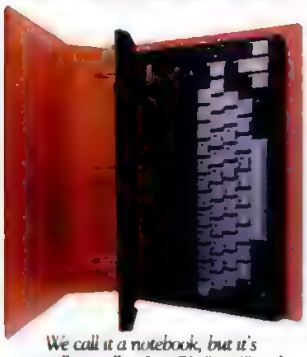

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The CDR-1100 comes with Laser Magnetic Storage's proprietary serial PC interface and device drivers, ribbon and audio cables, installation software, and Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), Version 2.21. In addition, the interface card has RCA jacks for connecting external speakers, but no connection for chaining additional devices. The unit can support the CD-ROM XA format via a software upgrade.

The sound quality of the CDR-1100 is fine for most applications, with only some distortion at full volume through the headphone jack. Motion video clips, however, quickly overflowed the drive's 32K buffer for slow, halting on-screen image playback at the drive's default settings—a problem we did not experience with the Laser Magnetic Storage unit, or any of the other drives based on that mechanism. Sequential thoughput measures are, however, consistent with the other 150-KBps (kilobytes per second) drives in our review.

Installation of this internal drive is quick and easy, with full updates to the AUTOEXEC.BAT and CONFIG.SYS files. Default IRQ and bus address settings may be altered directly from the card and from the automatic setup, but you have to take care to match them to the jumpers on the card. For fine-tuning performance, additional read buffers (beyond the buffer held on the interface card) may be allocated from system RAM and the default cache setting placed during setup. In addition, there are optional software parameters, including one to enable MSCDEX to use EMS, if it's available.

Caddyless operation makes the drive convenient for users who must change disks often, but it also means the drive is not as protective of your expensive CD-ROM disks as it could be. The manual push/pull Laser Magnetic Storage CD loading tray introduces opportunities to load dirt and dust into the mechanism along with the disk.

If you are on a tight budget, require an internal device, and are not interested in extras such as CD-ROM software, the CDR-1100 is an option, though cost-conscious users may also want to investigate the internal counterparts of two external devices reviewed here. These are the $490 LMS CM205 (which will likely be discounted to below $400 on the street) and Procom's version of the same drive, which lists for $325 without bundled CD-ROM software.

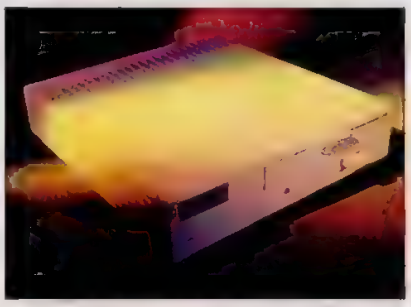
Texel

Texel DM-5024

BY JOSEPH DESPOSITO

The Texel DM-5024 is one of three CD-ROM drives we tested that operates at throughput rates up to 300 kilobytes per second (KBps). Along with producing correspondingly high marks on PC Magazine Labs' tests, the Texel DM-5024 offers a good value: The $699 list price includes both the drive and a SCSI interface. You can also buy the drive without a SCSI card for $599.

A nicely designed unit with a nearly square footprint, the DM-5024 has a hinged door that must be opened by hand to insert the CD-ROM caddy. The eject button is mechanical, rather than electronic, so you have to apply some pressure to the button to remove the caddy. The drive does not have double doors, but it has a sealed enclosure to help keep the unit free of dust. Another feature of this external drive is a built-in power supply that automatically senses if you're using a 110-volt or 220-volt power source.



FACT FILE

Texel DM-5024

Texel, 1605 Wyatt Dr., Santa Clara, CA 95054; 800-886-3935, 408-980-1838; fax, 408-980-1840

List price $599; with ISA SCSI interface, cables, and caddy, $699 DM-3024 internal version with SCSI interface, cables, and caddy, $499, PS/2 Kit with MCA SCSI interface, cables, and caddy, $739, Macintosh external version with cables and caddy, $679

Requires: 28K RAM, DOS 3.1 or later

In short: The Texel DM-5024 is a nicely designed drive that combines high throughput with a moderate price This SCSI drive, based on Texel's DM-3024 mechanism, deserves serious consideration

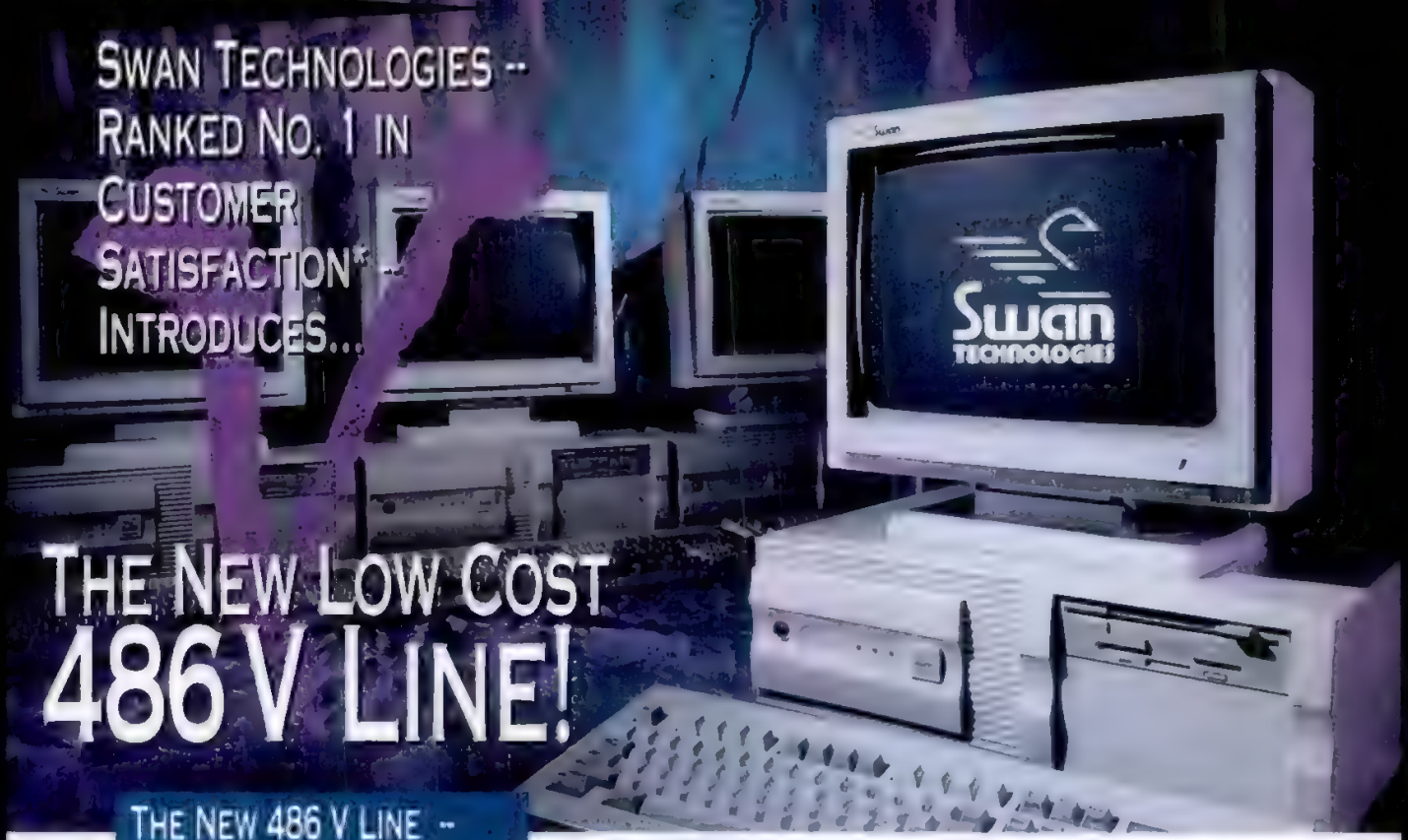
471 ON READER SERVICE CARD

PERFORMANCE

On our Sequential Throughput tests, the 265-ms DM-5024 produced the same solid results as the other 300-KBps drives we looked at. In addition, motion video played smoothly, and audio played with fine volume and clarity through the headphone jack. In addition to the headphone jack, the drive sports RCA jacks for audio output. The DM-5024 supports the CD-ROM XA standard (via software), CD-Interactive, and Kodak's single-session Photo CD format. By the time you read this, the drive should be shipping with Trantor's Music Box, which enables the drive to act like an audio CD player.

Included with the DM-5024 was the 8-bit Trantor T128 SCSI interface. On our first try at installation, the driver included with the system did not support audio; Texel had to send an updated driver to correct the problem. The second time around, installation went smoothly—all of the hardware and software defaults worked—except that a SETVER statement had to be added by hand to the CONFIG.SYS file. The cause of this was the version of Microsoft's MS-DOS CD-ROM Extensions (MSCDEX) shipped with the installation software on the review unit; Texel is currently shipping MSCDEX, Version 2.21, which should correct the problem.

Texel has manufactured CD-ROM drives for over two years (often for other companies), and is currently involved in building a network of distributors. The company, which manufactures its own drives in Japan, also sells an internal version of the DM-5024. This model, the DM-3024, sells for $499 as a standalone version or $599 with a SCSI interface card. A PS/2 kit for MicroChannel computers sells for $739 and includes the Trantor T228 SCSI interface. Texel also offers different bundles for the DM-5024, including a $1,099 business combination, a $1,249 multimedia set (with headphones, speakers, microphone, and more), and a $999 education pack; the same bundles are available with the internal drive. Texel sells direct, so don't



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*PC Magazine, Service and Reliability Survey - September 11, 1990
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With its high throughput, moderate price, and included SCSI controller, the Texel DM-5024 certainly rates your consideration.

Todd Enterprises Inc.

Todd TCDR 7000
Todd TCDR 7050

BY JOSEPH DESPOSITO

Encased in rugged steel housings, the Todd TCDR 7000 and Todd TCDR 7050 are built to last. These two external drives, which are based on Hitachi drive mechanisms, boast a mean time between failures (MTBF) rating of 50,000 hours and a two-year warranty on parts and labor. The TCDR 7000 is also designed for security: The product includes a unique key-lock feature.

▶ FACT FILE

Todd TCDR 7000

List price: With caddy, $845; CDR-3700 internal drive, $745; ISA proprietary adapter, $159, MCA interface kit, $249.

Requires: 4K RAM, DOS 3.3 or later.

Todd TCDR 7050

List price: With caddy, $915; CDR-3750 internal drive, $865, ISA 8-bit SCSI adapter kit, $199; ISA 16-bit SCSI adapter kit, $269; MCA interface kit, $289; Macintosh cable, $25

Requires: 4K RAM, DOS 3.3 or later.

In short: Both Todd drives sport high price tags, but offer ruggedness and a two-year warranty in return. The TCDR 7000 (based on a Hitachi CDR-3700 mechanism) has a special security lock, but the TCDR 7050 (based on a Hitachi CDR-3750) offers the flexibility of a SCSI interface. If you can pay the price, the performance and reliability of both drives should satisfy.

Todd Enterprises Inc., 224-49 67th Ave., Bayside, NY 11364; 800-445-8633; 718-343-1040; fax, 718-343-9180

472 ON READER SERVICE CARD

But this kind of quality comes at a price. The list price for the TCDR 7000 is $845 and the price for TCDR 7050 is and $915, and this doesn't include the cost of an interface kit. Half-height internal versions of these drives are available for $745 and $865, respectively.

The proprietary interface card we received for testing the TCDR 7000 is actually manufactured by Todd, but it is identical to the one that Hitachi provides for its Hitachi CDR-3700 internal drive. The TCDR 7000 also relies on the Hitachi CDR-3700 drive mechanism. With the proprietary interface card, the cost for the external TCDR 7000 rises to $1,004.

Although priced above even the double-speed drives we tested for this review, the TCDR 7000 and TCDR 7050 have a ruggedness that is appealing.

When paired with the 16-bit Trantor Systems T128F SCSI II interface ($269) supplied for our tested configuration, the external TCDR 7050 costs $1,184; this drive uses the Hitachi CDR-3750 drive mechanism. Todd can provide you with third-party 16-bit ISA SCSI interfaces for the TCDR 7050, as well as less expensive 8-bit cards, if you choose. You can also opt for an MCA interface kit for either drive: It costs $249 for the TCDR 7000 and $289 for the TCDR 7050. Street prices for the two drives run about $150 lower than list prices.

On PC Magazine Labs' Sequential Throughput test, both CD-ROM drives performed in the same range as the rest of the systems with throughput ratings of 150 kilobytes per second (KBps). A 64K buffer on each drive helps provide smooth video, and both products played audio without problems. Both the TCDR 7000 and TCDR 7050 have an airtight chassis and a double-door opening for a caddy. Both drives support the Kodak single-session Photo CD format and CD-Interactive.

Besides the addition of an external case, the TCDR-7000 distinguishes itself from the Hitachi CDR-3700 via a lock on the right rear side of that case. This feature prevents unauthorized users from removing CD-ROM disks from the drive.

For audio, each drive has a built-in headphone jack, but neither has RCA jacks; you'll need the TCDR 7000M and TCDR 7050M versions of the drives for this feature. These versions cost the same as the units we reviewed, but the TCDR 7000M forfeits the key-lock feature. The identical pricing for the TCDR 7050M and TCDR 7050 is a little unusual, since the TCDR 7050M gives up none of the features of the TCDR 7050 and adds the advantage of RCA jacks.

SETUP

Installing the TCDR 7000 was a breeze. The default settings on the TCD-IF8 interface card worked the first time, as did the default settings for the driver. With the TCDR 7050, however, the software setup had to be augmented by manually adding the SETVER command to the CONFIG.SYS file. This step wasn't required on the TCDR 7000 because that drive shipped with Version 2.21 of Microsoft's MS-DOS CD-ROM Extensions (MSCDEX), rather than Version 2.2. During the installation of the TCDR 7050, you can choose to set MSCDEX to use EMS memory.

Todd Enterprises has been in the CD-ROM drive business since 1986 and sells primarily to government and dealer channels. Along with the single-disk units reviewed here, Todd sells multiple drives in a single cabinet, as well as racks that hold up to 64 drives.

Although priced above even the double-speed drives we tested for this review, the TCDR 7000 and TCDR 7050 have a ruggedness that is appealing. And if keeping your CD-ROM disks secure is a primary concern, the TCDR 7000's ability to keep them safely locked away makes that unit a good choice. □

JOSEPH DESPOSITO, HENRY FERKSO-WEISS, PATRICK HONAN, GREG PASTRICK, AND JOHN R. QUAIN ARE FREQUENT CONTRIBUTORS TO *PC MAGAZINE*.

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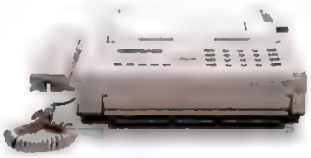

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CIRCLE 265 ON READER SERVICE CARD

27 Good Reasons To Buy A CD-ROM Player

If you've been sitting on the fence waiting for a compelling reason to buy a CD-ROM drive, it's time to make your move.

by Robin Raskin

The vast storage capacity of CD-ROMs makes them the ideal device for delivering huge amounts of information. Reference, education, and entertainment software are especially good candidates for CD-ROM media because they typically have large amounts of content and are often embellished with graphics and sound.

A CD-ROM can hold 680MB of data. If a typed double-spaced page holds about 1K of text and a page of the Encyclopedia Britannica holds about 10K, this means you could store over 600,000 typewritten pages or 60,000 encyclopedia pages on a single CD-ROM. Put another way, that's about 500 full-length murder mysteries or over 25 years of text from *PC Magazine.*

Of course, the CD-ROM is rarely used just to store text. Its large storage capacity is ideally

Photograph by Jeffrey Krein

suited for sound, graphics, and animation—rich formats that can result in gargantuan files. Hence, CD-ROMs are the right media for multimedia, which combines sound, text, and animation.

But even the 680MB of storage available on most CD-ROMs quickly runs out. A 24-bit color Super VGA uncompressed bitmap can take 1.5MB. A 24-bit SVGA video with enough frames for a 30-second animation would take up an entire CD-ROM. Red Book audio, the kind of sound a CD player produces, is limited to about an hour per disk. And that's only if the CD is dedicated entirely to sound.

APPROACHING MULTIMEDIA

Realizing that even a CD-ROM runs out of space, CD-ROM publishers are still toying with the perfect equation for an information-rich yet visually and aurally spellbinding CD-ROM experience. Currently, CD-ROMs take two distinct approaches to coexisting with the limits of today's technology: low tech or high tech. The low-tech route uses low resolution, fewer colors, smaller pictures, slow, jerky animation, and low-frequency audio cutoffs. Thus, pictures and sound take less space. This makes sense in certain reference applications where graphics and sound are secondary to content.

But while the small screen and grainy full-motion video on a CD-ROM such as IBM Corp. and the National Geographic Society's Mammals: A Multimedia Encyclopedia may wow computerphiles with its software-based full-motion video, it won't impress the MTV generation.

If done carefully, the low-tech route can be successful. The small-screen video in Sherlock Holmes: Consulting Detective works, in part, because there isn't much motion, and the well-executed sound diverts your attention from the low-quality video.

The high-tech products use a variety of space-saving methods. There are several new compression techniques, such as JPEG (Joint Photographic Experts Group), MPEG (Motion Pictures Experts Group), and fractal compression, that make it possible to store high-resolution images in less space. Microsoft's AVI (Audio Visual Interleave) standard (recently renamed Video1), which will begin to appear in CD-ROM software early next year, can accept a number of compression/decompression routines and play full 15- to 30-frame-per-second animations synchronized with sound. (The quality of the animation depends on the color and spatial resolution as well as your hardware platform.) Publishers can also replace bitmaps with more parsimonious vector drawings in order to save space. Similarly, they can replace digital CD audio with synthesized audio (.WAV files).

Less than five years ago, a phone directory on a CD-ROM cost about $10,000. Now there are at least two for under $200.

The costs of the high-tech approach are in the hardware. These techniques require fully-rigged multimedia machines, generously endowed with memory.

CD-ROM MANIA

Droves of publishers are testing the market. Once the turf of industrial-strength, text-based reference products, or a niche for gotta-have-the-latest technophiles, the CD-ROM market has boomed. There are literally thousands of CD-ROM titles available. Meckler's CD-ROMs in Print 1992: An International Guide to CD-ROM, CDI, CDTV and Electronic Book Products, available in either print or CD-ROM format, lists over 3,000 commercially available titles, more than double the number in 1991.

The disks now in print span an enormous range of materials. While we looked at titles with the greatest mass appeal, it's worth noting that there are many disks available for more vertical topics: medical data, statistical and census data, business data, phone/address directories, clip art, children's books, fonts, software demos, and programmers' references.

We found magnificent disks of planetary flybys (Orbits), collections of public-domain art (Publique Arte), an encyclopedia of aircraft and military equipment (Jane's Aircraft), and many biblical titles, from the Talmud to the New Testament.

For computerphiles, PC Magazine Select Demos, a collection of over 1,100 DOS- and Windows-based software demos published by Computer Library, a subsidiary of *PC Magazine*'s parent company, is a popular seller. Reference works from Borland International and Microsoft also now come on CD-ROM and include the companies' databases of known bugs and their fixes.

Also, full-blown applications like CorelDRAW; Microsoft Word for Windows and Bookshelf, Multimedia Edition; Microsoft Works for Windows, Multimedia Edition; and Multimedia SmartHelp for 1-2-3 Windows are all available on CD-ROM. The executable files still get installed to run off your faster hard disk, but the adjunct materials—extensive online help combining graphics, sound, clip art, fonts, and other space-hoggers—reside on the CD-ROM.

Prices of CD-ROMs are plummeting. Less than five years ago, a phone directory on a CD-ROM cost about $10,000. Now there are at least two comprehensive phone directories containing millions of listings each; PhoneDisk (DAK Industries) and ProPhone (ProCD) each cost under $200.

THE CONTENT HAYSTACK

The most critical component of a CD-ROM is content. Content refers not only to the quality of the information on the CD-ROM, but also to how that information is presented. The text must be well written and well organized. The CD-ROM must be indexed and searchable.

To make the data accessible, you need a search engine or a highly structured organization. In its simplest form, the search engine may look for keywords in an index; a more sophisticated form may include Boolean and wildcard searches, and even searches for the audio contents.

But raw searching is not an especially efficient way to browse data. You should

Our Contributors: ROBIN RASKIN is an executive editor of *PC Magazine*. ADAM A. HICKS is an editorial trainee at *PC Magazine*. RUBIN RABINOVITZ is a professor of English at the University of Colorado and a contributor to *PC Magazine*. DON TRIVETTE is a frequent contributor to *PC Magazine*'s After Hours section.

be able to navigate through information in a nonlinear way—using hyperlinks in which keywords cross-refer to each other along the way. Overall, link and search technologies suffer the same fundamental problems on CD-ROMs as they do in print. The indexes are insufficient or contain references out of context.

Searching a CD-ROM index also takes time. And since the CD-ROM drive is much slower than a hard disk, many CD-ROM publishers take the quick and dirty way out. Instead of fine-tuning their search engines, they load the index onto your faster hard disk. As a result, some CD-ROM titles also demand a lot of hard disk space (up to 8MB). We point the culprits out in our reviews.

YOU DIDN'T EXPECT IT TO BE ALL FUN AND GAMES, DID YOU?

With CD-ROM publishing techniques still in their infancy, there is quite a bit of experimentation. The results can be frustrating for end users. Many CD-ROM installation programs modify AUTOEXEC.BAT, CONFIG.SYS, and WIN.INI files without warning so they can increase the size of your files and buffer statements. The net effect is more tech support calls and aggravated users.

Some disks, such as Microsoft Bookshelf, use digitized sound; this means users need a sound card like the Sound Blaster for the audio. Others, like Compton's MultiMedia Encyclopedia for Windows, use Red Book audio, which means you don't need a special card; you can hear sound through the phone jack in the CD-ROM drive. A few programs, like Great Wonders of the World, mix the two types of sound, with the annoying result that volume levels differ for different playback modes. And despite the faster access times of new CD-ROMs, you'll often experience digital sound that plays back in fits and starts.

FUTURE PROMISES

The CD-ROM market promises to be tumultuous and satisfying in the next year. Major publishers are busily converting their best-selling reference titles to CD-ROM. The publishing world is quietly gearing up for the day when reference books, at least, are produced simultaneously in paper and CD-ROM formats.

Digital video techniques that play animations from your CD-ROM or hard disk at the respectable rates of 15 to 30 frames per second are about to flood the market. Microsoft's AVI (Audio Visual Interleave); Intel Corp.'s DVI (Digital Video Interactive), recently redubbed Indeo; and even Apple Computer's Quicktime on a PC—all capable of bringing you digital movies—are three of the emerging standards that will duke it out for a place on your disk. Eastman Kodak Co.'s Photo CD, which now requires CD-ROM XA–compatible drives or Kodak's Photo CD drive, will make it possible to shoot 35mm film and store it on a CD-ROM.

You could sit on the fence and wait for this industry to mature, or you could plunge right in and get an indoctrination into the future. We think that once you read the accompanying reviews, you won't want to wait.

Reference Works on CD-ROM

BY RUBIN RABINOVITZ

Working with CD-ROM reference tools is like traveling on an ocean liner: slow and expensive, but also the most luxurious way to go. CD-ROM disks can store trunkfuls of data and spoil you with extravagances such as sound excerpts, illustrations, and video clips. Tempted? Below is a sampler of some of the most useful and feature-rich reference tools on CD-ROM.

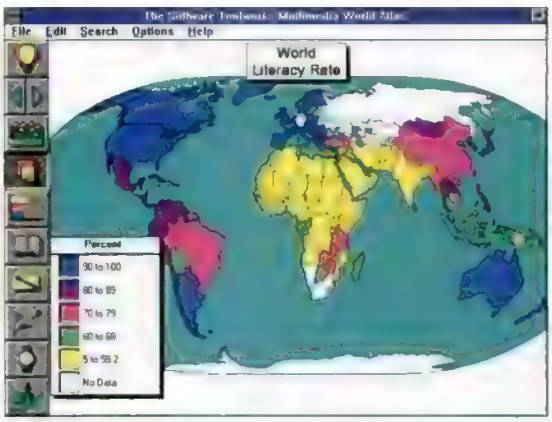
Atlases

1. Software Toolworks World Atlas MPC

Software Toolworks World Atlas MPC is sleek, engaging, and stocked with dozens of well-integrated multimedia features. At the core of the program are 240 color maps, 4,400 statistical maps, and a 300-article database of geographical information on topics such as ethnic groups, climate, natural resources, literacy, health, and economics. The graphs and statistical maps bring to life dry figures pertaining to literacy, population density, agricultural exports, manufacturing centers, mineral production, and similar subjects. (A companion program, Software Toolworks U.S. Atlas, is also available; it has over 1,000 statistical maps for data from states and counties in the U.S.)

Along with maps, World Atlas displays the flag of a country and plays its national anthem. You can sound out the names of cities and countries; if you click on a major city, you'll get information about its population, telephone code, latitude and longitude, and average temperatures. An atlas should be attractive and enjoyable as well as informative; World Atlas is all of these.

Software Toolworks World Atlas MPC
The Software Toolworks, 60 Leveroni Ct., Novato CA 94949; 800-231-3088.
List price: $149.
Requires: 386-based PC or better, 2MB RAM, CD-ROM drive, VGA display subsystem, sound board, DOS 3.1 or later, Microsoft Windows 3.0 or later, MS-DOS CD-ROM Extensions, headphones or speakers. Mouse recommended.
Circle 494 on reader service card



Software Toolworks World Atlas MPC can display thousands of statistical maps; this one shows world literacy rates.

2. Street Atlas USA

If you think a program that maps every street in the country is boring, you're in

for a surprise: Street Atlas USA is fascinating. You begin by looking at a map of the U.S. and zoom in until you start seeing towns and streets. If you wish, you can travel cross-country, traversing a series of seamlessly integrated maps. Or, you can type in the name of your old hometown (or its ZIP code or area code) and feel nostalgic as you read the names of long-forgotten streets.

Street Atlas USA shows features such as highway numbers, points of interest, and bodies of water. If you export the program's maps into Paintbrush, you can print them. Street Atlas USA supports only black-and-white printing; but MapExpert, a larger version of the program, can print in color, produce oversize maps, and perform advanced cartographic functions. Street Atlas USA is an elegant software package; it's impressive in the amount of data it offers and yet marvelously easy to use.

Street Atlas USA
DeLorme Mapping Co., Lower Main St., P.O. Box 298, Freeport, Maine 04032; 207-865-1234.
List price: $169.
Requires: 640K RAM (600K free within Microsoft Windows), CD-ROM drive, VGA monitor, DOS 4.1 or later, Windows 3.0 or later. 386-based PC recommended.
Circle 495 on reader service card

Dictionaries

3. Macmillan Dictionary for Children

The Macmillan Dictionary for Children, recommended for ages 7 to 12, has 12,000 word entries, 1,000 illustrations, and 400 sound effects.

A pleasant audiovisual guided tour will get your young philologist up to speed, and there are word games and a cartoon character to sustain his or her interest in the program. Clicking on words in definitions will sound them out—just the thing for a child learning to read. The Macmillan Dictionary for Children is a gem, with enough color, sound, and movement to elicit sparkles of interest in Nintendo-glazed eyes.

Macmillan Dictionary for Children
Macmillan New Media, 124 Mount Auburn St., Cambridge, MA 02138; 617-661-2955.
List price: $59.95.
Requires: 386-based PC or better, 4MB RAM, CD-ROM drive, MPC-compatible sound board, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, MS-DOS CD-ROM Extensions 2.2 or later, headphones or speakers, mouse.
Circle 496 on reader service card

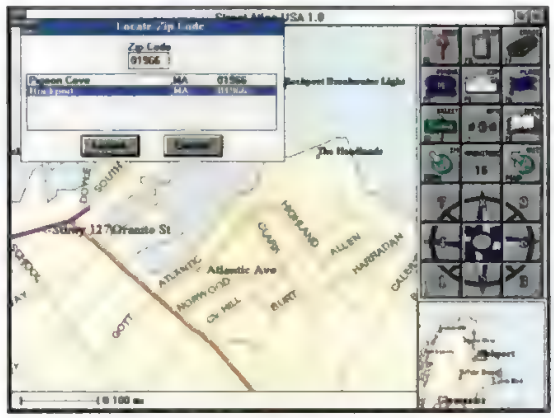
4. The Oxford English Dictionary, Second Edition, on Compact Disc

The Oxford English Dictionary—over a century in the making—is both the granddaddy and heavyweight champion of the reference-work world. The recently released second edition contains 249,000 etymological listings, 137,000 pronunciation guides, 2.4 million illustrative quotations, and 615,500 entries (the 2,600-page *Webster's Third International Dictionary* has 450,000).

The printed version of the second edition fills 20 hefty volumes and costs $2,750, which almost makes the $895 CD-ROM version seem reasonably priced. But although it's cheaper, the electronic dictionary is a more useful tool than the printed version. Its array of powerful search routines can save hours of tedious labor, and its cross-referencing feature can instantly define any word that appears in another word's definition text.

Learning how to set up complex searches can take patience: the second edition of OED uses a query language something like those in database programs. In addition, some of the program's command sequences are awkward, and its documentation is often sketchy. The latest edition of OED is a high-end product aimed at institutions and a small group of individual users: philologists with trust funds. But if you happen to belong to that group, this is the Christmas present of your dreams.

The Oxford English Dictionary, Second Edition, on Compact Disc
Oxford University Press, Electronic Publishing, 200 Madison Ave., New York, NY 10016; 800-334-4249, ext. 7127, 212-679-7300, ext. 7127.
List price: $895.
Requires: 386-based PC or better, 4MB hard disk space, CD-ROM drive, Microsoft Windows 3.0 or later, MS-DOS CD-ROM Extensions 2.0 or later, mouse.
Circle 497 on reader service card



Zippy maps: Street Atlas USA lets you enter ZIP codes to display maps of any part of the country.

Encyclopedias

5. Compton's MultiMedia Encyclopedia for Windows

The data and writing style of Compton's MultiMedia Encyclopedia for Windows are geared to readers age 8 and up; it's essentially a student-level encyclopedia. The CD-ROM disk contains all the text of the printed edition's 26 volumes together with 60 minutes of sound, 43 animated sequences, and 13,000 images, maps, and graphs. Also included are an atlas and a 65,000-word dictionary.

Compton's comes with a retrieval engine and an assortment of easy-to-use routines for finding information like the Topic Tree, which starts with general headings and then takes you to subcategories. Another option displays a time line of American history and lets you click on relevant items; thus you could move to the 1960s, read an article about John F. Kennedy, and hear an excerpt from his inaugural address.

Icons in the margins of the text give you a choice of useful options. For example, an article on animals offers a cross-reference on the way fish breath, a display showing the speeds of different mammals, an audio segment on whales, a picture of an anteater, and an animation showing how snakes move. The program's drawbacks are its $695 price tag and its appetite for hard disk space (5MB).

Coming Attractions: *Encyclopedias*

Encyclopedias have often been CD-ROM best-sellers, and the battle for market dominance has been heating up. While preparing this article we were able to get sneak previews of three innovative new encyclopedias. Both Compton's Interactive Encyclopedia and the New Grolier Multimedia Encyclopedia for Windows will be released in time for Christmas shopping, while Microsoft Encarta will be available in early 1993. All will have a list price of $395.

Compton's Interactive Encyclopedia: This revamped version is virtually identical in content to Compton's MultiMedia Encyclopedia for Windows. The interactive version includes digital video clips, a toolbar that can be placed anywhere on-screen, and an advanced version of the dictionary. A new feature called Virtual Workspace lets you open a series of encyclopedia pages in "virtual windows" and then navigate from one to the other with a mouse.

Microsoft Encarta: Well designed, easy to use, and crammed with state-of-the-art features, Microsoft Encarta is to encyclopedias what Excel is to spreadsheets. Its handsome interface makes Encarta one of the best-looking products ever beamed across a VGA monitor.

New Grolier Multimedia Encyclopedia for Windows: The New Grolier Electronic Encyclopedia has been the most authoritative electronic encyclopedia around, if somewhat plain-Jane in its DOS implementation. The Windows version changes all that: It's clean, crisp, and easy to work with.—*RR and RR*

Compton's MultiMedia Encyclopedia for Windows
Compton's NewMedia, 2320 Camino Vida Roble, Carlsbad, CA 92009; 800-532-3766.
List price: $695.
Requires: 5MB hard disk, CD-ROM drive with audio output, sound board, DOS 3.3 or later, Microsoft Windows 3.0 or later, headphones or speakers, mouse.
Circle 498 on reader service card

6. New Grolier Multimedia Encyclopedia

The New Grolier Multimedia Encyclopedia is a bit larger than Compton's MultiMedia Encyclopedia for Windows, much cheaper ($395), and also a stronger research tool: Its sources are more authoritative, its search engine is better, and its bibliographical references are ampler.

Based on the 21-volume *American Academic Encyclopedia,* the New Grolier Multimedia Encyclopedia contains 33,000 articles (7,000 new to this edition), 30 minutes of sound, and 3,000 illustrations. Many of the images are attractive full-screen color displays, some with sound; thus while looking at a picture of a curlew, you can hear its call. There also are some intriguing videos, such as time-lapse sequences of flowers opening.

Like the best on-line reference works, Grolier offers you many paths into its database. You can use either simple or complex (Boolean) searches or follow a logical path from general headings to specific subjects. A time line leads you through chronologically arranged events from 40,000 B.C. to A.D. 1990; you also can browse through a title index, a map index, or a picture index. Grolier's main disadvantage is its drab DOS interface; however, Grolier says a multimedia Windows version should be available by the time you read this.

If you're shipwrecked on a desert island with an electrical outlet, Great Literature Personal Library Series is the disk of choice.

New Grolier Multimedia Encyclopedia
Grolier Electronic Publishing Inc., Sherman Turnpike, Danbury, CT 06816; 800-356-5590.
List price: $395.
Requires: 640K RAM, 1MB hard disk space, CD-ROM drive, VGA display subsystem, sound board, DOS 3.1 or later, MS-DOS CD-ROM Extensions 2.1 or later, headphones or speakers, mouse.
Circle 499 on reader service card

Other Reference Works

7. Great Literature Personal Library Series

Great Literature Personal Library Series fulfills the dream of CD-ROM visionaries: a library that can fit in your pocket. The program offers 1,869 titles: poems, novels, plays, and essays as well as scientific, historical, philosophical, and religious documents. There are works by Addison, Aeschylus, Aesop, Aristophanes, Augustine—but you get the idea. A retrieval engine lets you find works by subject, author, or title; you can also perform word searches to find elusive passages or recurring themes. Great Literature's multimedia features are often amateurish, but this program isn't about sound effects or graphics—it's about the seminal works of Western civilization. If you're shipwrecked on a desert island with an electrical outlet, Great Literature is the disk of choice.

Great Literature Personal Library Series
Bureau Development Inc., 141 New Rd., Parsippany, NJ 07054; 800-828-4766.
List price: $99.
Requires: 640K RAM, CD-ROM drive, VGA display subsystem, sound board, DOS 3.1 or later, MS-DOS CD-ROM Extensions 2.0 or later, headphones or speakers.
Circle 500 on reader service card

8. Great Wonders of the World, Volume 1

Great Wonders of the World, Volume 1, is to CD-ROMs what *National Geographic* is to periodicals: part textbook and part travel brochure. The program, an audiovisual depiction of man-made marvels, focuses on notable buildings (the Chartres Cathedral, the Egyptian pyramids, the Taj Mahal) and construction projects (the Great Wall of China,

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(Lease it for $88.76 per month)*

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the Empire State Building, the Trans-Siberian RR). You can get information about the different sites in a variety of ways: short videos, narrated slide shows, maps, and historical outlines. Hypertext links connect the text and illustrations; a glossary defines unfamiliar terms; and a time line lets you scroll through relevant historical events chronologically.

Great Wonders has a few glitches. It runs slowly, the installation is bumpy, and the sound levels aren't uniform across the program. But it does provide a congenial way to learn about geography.

Great Wonders of the World, Volume 1
Interoptica Limited, 300 Montgomery St., 2nd floor, San Francisco, CA 94104; 415-788-8788.
List price: $79.95.
Requires: 1.2MB RAM, CD-ROM drive, Super VGA adapter, sound board, DOS 3.1 or later, Microsoft Windows 3.1 or later, headphones or speakers.
Circle 501 on reader service card

9. McGraw Hill Science and Technical Reference Set, Release 2.0

The McGraw Hill Science and Technical Reference Set is based on a dictionary of scientific and technical terms (117,000 entries) and a condensed version of McGraw Hill's 20-volume scientific encyclopedia (7,700 articles and 1,700 illustrations). The program offers three entry paths to its database: an alpha search of the disk, an expandable table of contents, and a series of graphics—actually decorated charts—that show different scientific fields. You won't love the program's unwieldy command structure, workaday illustrations, and unimaginative interface. But it clearly offers a great deal of valuable, well researched information.

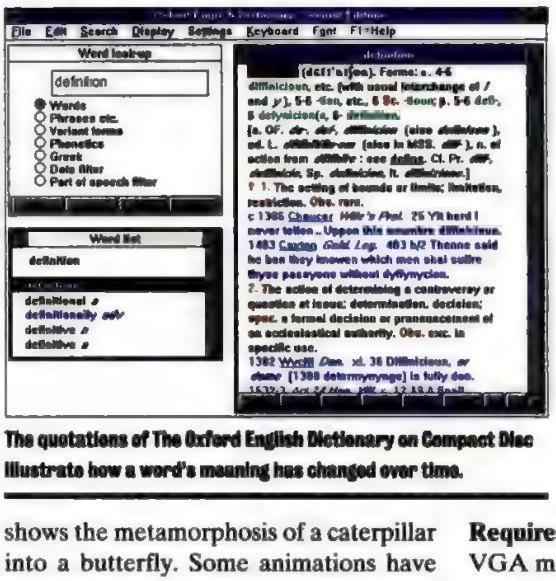
McGraw Hill Science and Technical Reference Set, Release 2.0
McGraw Hill Inc., 11 W. 19th St., New York, NY 10011; 800-722-4726.
List price: $495.
Requires: 1MB RAM with expanded memory, 2MB hard disk space, CD-ROM drive, VGA monitor, DOS 3.1 or later.
Circle 502 on reader service card

10. Microsoft Bookshelf, 1992 Multimedia Edition

Microsoft Bookshelf, a collection of reference works (a dictionary, an atlas, an encyclopedia, a thesaurus, an almanac, and two quotation dictionaries), is in its second release as a multimedia Windows version. This edition has a new almanac with data through 1991; an updated atlas (the U.S.S.R. is now the Commonwealth of Independent States); and added animations, illustrations, sound files, and cross-references.

The most improved volume is the atlas. You can click on Africa to get a map of Burkina Faso, display that country's flag, and play its national anthem. If you click on the capital, Ouagadougou, you'll hear its name pronounced—in this instance, a most helpful feature.

There are also a number of welcome audiovisual enhancements in Bookshelf's encyclopedia, such as an animation that shows the metamorphosis of a caterpillar into a butterfly. Some animations have sound in the background, such as the one in which an explanatory narrative accompanies an animation showing a jet engine firing.



The quotations of The Oxford English Dictionary on Compact Disc illustrate how a word's meaning has changed over time.

Bookshelf also includes ingenious musical demonstrations, such as one on counterpoint that lets you play individual lines of music and then hear the effect when they're combined. Bookshelf would be more useful if its dictionary and thesaurus were as powerful as those of rival on-line reference works, but even so, this is a package with many useful tools. If you plan to buy only one CD-ROM reference work, Bookshelf is a good choice.

Microsoft Bookshelf, 1992 Multimedia Edition
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400.
List price: $195; update, $49.95.
Requires: 386-based PC or better, 2MB RAM, 30MB hard disk, CD-ROM drive, sound board, Microsoft Windows 3.1 or later, headphones or speakers, mouse.
Circle 503 on reader service card

11. 1991 TIME Magazine Compact Almanac

Remember when doing research meant sitting in a darkened room in front of a microfilm machine? Putting periodicals on CD-ROMs makes life easier, and that's the philosophy behind the 1991 TIME Magazine Compact Almanac. This edition covers events from 1989 to September 1991 and gives speedy access to 10,000 articles. It includes portraits of selected *TIME* cover subjects, maps, an almanac, the 1991 CIA World Factbook, tables from the *USA Statistical Abstracts,* and a quiz; annual editions will keep the product up-to-date. The retrieval engine and multimedia effects could be improved, but working with the disk beats cranking through spools of microfilm.

1991 TIME Magazine Compact Almanac
Compact Publishing, 5141 MacArthur Blvd., Washington D.C. 20016; 800-964-1518.
List price: $149.95; school and library edition, $195.
Requires: 640K RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.3 or later, headphones or speakers.
Circle 504 on reader service card

12. Vital Signs: The Good Health Resource

Do you subscribe to health magazines? Perform do-it-yourself diagnoses? If so, Vital Signs: The Good Health Resource, is (so to speak) just what the doctor ordered. At the core of this health-resource reference disk is a large collection of articles covering various disorders. There are explanations of safety procedures, audio segments in English and Spanish, and address lists for disease-information hot lines, poison-control centers, and support groups. You can use multi-item word searches to find relevant data; thus looking for *sore throat* and *fever* will lead you to the articles where both terms appear.

Best of all, Vital Signs gives you this information succinctly and intelligibly.
Vital Signs: The Good Health Resource
Texas Caviar Inc., 3933 Steck Ave., Suite B-115, Austin, TX 78759; 512-346-7887.
List price: $95.
Requires: 2MB RAM, CD-ROM drive with Red Book audio capability, EGA or VGA display subsystem, sound board, DOS 3.1 or later, Microsoft Windows 3.0 or later, headphones or speakers.
Circle 505 on reader service card

CD-ROM for Entertainment And Education

BY DON TRIVETTE

To stretch your horizons or to rest your aching mind, crack open one of these CD-ROM titles and explore.

For the Very Young

CD-ROM sound capabilities open a new world for nonreaders. Finally, parents can disappear from sight for a few moments and not worry that the prereader will be lost. These games are wonderfully entertaining and in most cases educational.

13. Annabel's Dream of Ancient Egypt

This is a charmingly narrated tale about a cat named Annabel and her sisters. In a dream, Annabel visits the land of the Pharaohs and hears the story of Aida—an Ethiopian princess who is captured and taken to Egypt as a slave. Admist slavery the princess retains her royal bearing and dignity. When Annabel awakens she must contend with sibling rivalry, but she remembers the lessons of her dream.

The Egyptian theme is repeated through a smorgasbord of educational activities, including instructions for paper making, pictures of ancient Egypt, a secret message/hieroglyphics translator, and reading/listening sessions on *Aîda.*
Annabel's Dream of Ancient Egypt
Texas Caviar Inc., 3933 Steck Ave., Suite B-115, Austin, TX 78759; 512-346-7887.
List price: $85.
Requires: 2MB RAM, CD-ROM drive, sound board, DOS 3.1 or later, Microsoft Windows 3.0 or later, headphones or speakers, mouse.
Circle 506 on reader service card

14. Just Grandma and Me

Just Grandma and Me, adapted from the Mercer Mayer storybook of the same name, is the first in a series of Broderbund Software's Living Books. It sets new standards for children's software.

The plot finds Little Critter and Grandma spending a day exploring the beach; each page has one or two sentences the computer speaks aloud. On each page the child is encouraged to explore the environment. Click an item and it springs to life. You meet a starfish, a flying kite, a talking conch, and lots of other creatures in this ten-page multimedia book. The graphics and sound are superb, the interface is ideal for young children, and the written and spoken text comes in English, Japanese, or Spanish.

Step inside a multimedia book with Just Grandma and Me, based on the Mercer Mayer children's series.

Just Grandma and Me
Broderbund Software Inc., 500 Redwood Blvd., Novato, CA 94948; 800-521-6263.
List price: $49.95.
Requires: 16-MHz 286-based PC or better, 4MB RAM, CD-ROM drive, Super VGA monitor, sound board, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, headphones or speakers, mouse.
Circle 507 on reader service card

15. Mixed Up Mother Goose

Young kids love being involved in a Mother Goose mystery. This CD-ROM is a rich animated adventure where a child wanders about Mother Goose Land trying to match 18 nursery rhyme characters with their missing objects. Jack is sans candlestick, and Old King Cole, once a merry old soul, now grieves over a missing bowl of cherries.

Each character tells the child what he or she has lost, and, when it's returned, they recite and act out a Mother Goose rhyme. Map and navigational skills are learned. Animation, music, speech, and sound effects are all included, as is support for English, French, German, Japanese, and Spanish dialog. Wait until you see a cow jump over the moon.
Mixed Up Mother Goose
Sierra On-Line, P.O. Box 485, Coarsegold, CA 93614; 800-326-6654.
List price: $69.95.
Requires: 386-based PC or better, 2MB RAM, CD-ROM drive, VGA monitor, sound board, headphones or speakers, mouse.
Circle 508 on reader service card

16. Where in the World is Carmen Sandiego?, Deluxe Edition

Carmen Sandiego is the wildly popular villainess you pursue through time and place. The only way to find her is to learn a bit of history, geology, geography, and political trivia skillfully woven into the plot.

The closest thing we have to a PC superstar, with four sequel PC games, a couple of books, and her own television show, the main character of the CD-ROM version is based on the original Carmen. Included are 130 stunning digitized color photographs from the collection of the National Geographic Society, improved sound (a full score and the Smithsonian/Folkways music recordings of 150 traditional folk songs), character voices, 3,000 clues, hundreds of animations, more villains, and better on-screen sleuthing tools like a videophone. If you liked the original, you'll love the new and improved version.

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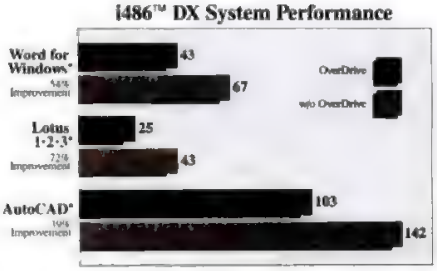

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Where in the World is Carmen Sandiego?, Deluxe Edition
Broderbund Software Inc., 500 Redwood Blvd., Novato, CA 94948; 800-521-6263.
List price: $80.
Requires: 286-based PC or better, 640K RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.1 or later, headphones or speakers, mouse. Copy protected (requires user to enter code from user manual).
Circle 509 on reader service card

For Kids of All Ages

Adventure games, board games, and murder mysteries find their way to the shiny disk. . .usually by way of the floppy disk. Of these titles, only Sherlock Holmes: Consulting Detective is native to CD-ROM.

17. Battle Chess Enhanced CD-ROM

There are plenty of chess-playing computer games, but only Battle Chess Enhanced CD-ROM offers a 3-D medieval war waged on a chessboard. One piece doesn't just capture another, it engages in armed combat to slay the opponent. Sound effects and beautiful animation add to the entertainment.

With a library of 30,000 opening moves, Battle Chess is not the grand master of computer chess, but it's not all that easy to beat either. There are ten skill levels, and if you tire of the theatrics, you can switch to conventional 2-D play. You can play against the computer, another person, or even via modem hookup with another person. But perhaps the best part of Battle Chess is its enthralling 30-minute animated tutorial, where each of the chess pieces comes to life and explains its personal history and capabilities.

Battle Chess Enhanced CD-ROM
Interplay Productions Inc., 3710 S. Susan, #100, Santa Ana, CA 92704; 714-553-6655.
List price: $79.95.
Requires: 386-based PC or better, 3MB RAM, CD-ROM drive, 256-color Super VGA monitor, sound board, Microsoft Windows 3.0 with Multimedia Extensions or Microsoft Windows 3.1 or later, headphones or speakers, mouse.
Circle 510 on reader service card

18. King's Quest V

King Graham returns to the quest as he tries to rescue his family and home, which were swept away by the evil wizard Mordack. The CD-ROM version of this best-seller is a rich adventure, but it's impossibly slow when running under Microsoft Windows. Fortunately, it loads and runs under DOS without sacrificing a bit of the great multimedia effects. The CD-ROM version has no on-screen text; everything is spoken by actors. King's Quest VI, the latest in the series, will be available on CD-ROM in early 1993.

In Battle Chess Enhanced CD-ROM, one piece doesn't just capture another, it engages in armed combat.

King's Quest V
Sierra On-Line, P.O. Box 485, Coarsegold, CA 93614; 800-326-6654.
List price: $69.95.
Requires: 386-based PC or better, 2MB RAM, CD-ROM drive, VGA monitor, sound board, Microsoft Windows 3.0 or later (for included Windows version), headphones or speakers, mouse. Copy protected (requires user to enter code from user manual).
Circle 511 on reader service card

King's Quest V, the CD-ROM version, replaces the on-screen text of the floppy version with true character speech.

19. Sherlock Holmes: Consulting Detective

Four men dead: a coincidence or could they be the victims of a 4,000-year-old mummy's curse? That's one of the three mysteries in Sherlock Holmes: Consulting Detective. Produced in the style of a motion picture, Holmes has 90 minutes of full-motion video and dozens of speaking parts. After interviews with the suspects and characters, you deduce the killer and bring him to justice. The DOS-based Holmes requires a fast CD-ROM drive and computer; anything less and the action will be jerky and broken. This is one of the few games made solely for multimedia and well worth a look.

Sherlock Holmes: Consulting Detective
ICOM Simulations Inc., 648 S. Wheeling Rd., Wheeling, IL 60090; 800-877-4266.
List price: $69.95.
Requires: 12-MHz 286-based PC or better, 640K RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.3 or later, headphones or speakers, mouse.
Circle 512 on reader service card

The Finer Arts

These CD-ROMs can enrich your life with art, language, music, and the movies.

20. Berlitz: Think & Talk French

Learn French (German, Italian, and Spanish versions are also available) using the proven four-step Berlitz method: listen and understand, read, write, and think and talk. After 55 to 65 hours of studying these disks, Berlitz claims you'll know your language.

In 50 lessons you hear, read, write, and speak French. It's a completely conversational approach; there are no formal rules of grammar or vocabularies to memorize. As the narrator speaks on audio CD, you see the French words on-screen along with related illustrations. After repeating each lesson you eventually deduce the meanings of the words; there are no translations to English to guide you except for an on-screen dictionary. The technique, called total immersion, helped popularize the Berlitz approach.

The seven audio CDs (Red Book) contain more than 11 hours of narration

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CIRCLE 141 ON READER SERVICE CARD

and instruction—all in French. Only the first disk houses data. Five to six lessons are installed on the hard disk at a time, then they're removed and replaced with the next set; this keeps the CD-ROM drive free for the audio disks and speeds up access to the lessons as well. Each lesson has a practice exercise—oral or written. An unusual feature lets you record 20 seconds of your own speech in a hard disk file and play it back to compare it with the CD tutor's. (All you need is a microphone for your CD-ROM drive.)

Berlitz: Think & Talk French
HyperGlot Software Co. Inc., P.O. Box 10746, Knoxville, TN 37939; 800-726-5087.
List price: $199.
Requires: 2MB RAM, 5MB hard disk space, CD-ROM drive, VGA monitor, sound board, DOS 3.3 or later, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, headphones or speakers, mouse.
Circle 513 on reader service card

21. Cinemania

This is the home film buff's companion, with capsule reviews of 19,000 movies and detailed reviews of 750 others. Reviews are culled from the text of Leonard Maltin's Movie and Video Guide, 1992; other sources of information, including the *Encyclopedia of Film* and the *Motion Picture Guide,* augment the reviews. The reviews span from the early days of moviemaking to the present (1914 to 1991). (1992 movies await next year's update.)

You can view a long list of casts, credits, and awards for major motion pictures. You can hear audio clips ("Frankly, my dear. . .") and view any of 1,000 photographs of famous scenes and stars. There's a biography section on actors, directors, and other cinema notables and an encyclopedia to explain topics like colorization. Of course you can search by genre, actor, director, MPAA rating, and awards.

Cinemania
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400.
List price: $79.95.
Requires: 386SX-based PC or better, 2MB RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.1 or later, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, headphones or speakers, mouse.
Circle 514 on reader service card

22. Composer Quest

Composer Quest intertwines music, art, and history. A time line is the navigational tool for exploring seven periods of music, from the early baroque to the classical and romantic periods to early modern. There's a separate jazz time line for ragtime, Dixieland, and early swing.

In Composer Quest, a time line is the navigational tool for exploring seven periods of music, from the early baroque to early modern.

In the romantic period, for example, listen to short musical excerpts (in Red Book audio) from the works of Brahms, Verdi, and Wagner as you read their biographies. Click on the art-book icon and learn about Cézanne, Manet, and Renoir—painters during the same period. Another icon brings up a concise history of the period: the industrial revolution and imperialism. By combining the three, you get a true sense of the romantic milieu. When you've heard and read enough, switch to the Composer Quest game—a highbrow version of "Name That Tune."

Composer Quest
Dr. T's Music Software Inc., 124 Crescent Rd., Needham, MA 02194; 800-989-6434.
List price: $99.
Requires: 386-based PC or better, 2MB RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.1 or later, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, headphones or speakers, mouse.
Circle 515 on reader service card

23. Multimedia Beethoven: The Ninth Symphony

Here's one that belongs on everyone's short list of CD-ROM classics. Professor Robert Winter, a world-renowned authority on Beethoven, is our guide to the

For More Information

Need more information about CD-ROMs? Some 200 of the most popular disks (as well as drives and accessories) are described and distributed through a catalog published by the Bureau of Electronic Publishing (800-828-4766). The bureau also offers CD-Online Library, a free service to preview the CD-ROM titles via modem (at 300 to 2,400 bps) for up to 10 minutes at a time. To find out more about the service and get the required CD-Online Library password, call 201-808-2700.

For more comprehensive guides, try The CD-ROM Directory or CD-ROMs in Print 1992: An International Guide to CD-ROM, CDI, CDTV and Electronic Book Products. Both of these directories are available in printed form and—appropriately—on easy-to-use, searchable CD-ROM disks. □

The CD-ROM Directory
UniDisc, 3941 Cherryvale Ave., #1, Soquel, CA 95073; 408-464-0707
List price: Printed version (annual), $149 plus $7.50 shipping; CD-ROM version (two disks annually), $199 plus $10 shipping.
Requires (CD-ROM version): 640K RAM, CD-ROM drive, DOS 3.0 or later, MS-DOS CD-ROM Extensions.
Circle 516 on reader service card

CD-ROMs in Print 1992: An International Guide to CD-ROM, CDI, CDTV and Electronic Book Products
Meckler, 11 Ferry Ln. West, Westport, CT 06880; 800-635-5537
List price: Printed version, $65 (1993 version, $95); CD-ROM version, $95.
Requires (CD-ROM version): 512K RAM, CD-ROM drive, DOS 3.0 or later, MS-DOS CD-ROM Extensions.
Circle 517 on reader service card

A COMPLETE LISTING

CD-ROMs for Your Multimedia PC

There are more than 3,000 commercially available CD-ROMs in print. This is double the number listed last year, and with new titles coming every day, the number could easily double by next year's listing. Of all the emerging CD-ROM multimedia-capable standards at present, the one that's most appealing to the vast majority of users, and most ubiquitous in the sheer number of titles, is the MPC standard set by the Multimedia PC Marketing Council.

BY ADAM A. HICKS

Why MPC?

You can be reasonably sure that MPC titles incorporate a blend of text, graphics, animation, and audio. Though the MPC logo does not guarantee a full multimedia environment with all of these components, most of the publishers do take advantage of the full MPC platform.

MPC software is designed to run on MPC-compatible machines with these minimum requirements:

- 386-based PC or better;
- 2MB RAM;
- 30MB hard disk;
- CD-ROM drive capable of transferring data at a sustained rate of 150 kilobytes per second (KBps) without taking up more than 40 percent of your CPU's time, and with an average seek time of 1 second or less;
- 8-bit wave audio (digitized sound) and MIDI (music synthesizer) playback;
- Microsoft Windows 3.0 with Multimedia Extensions, or Windows 3.1.

At the time we went to print, the list of CD-ROM titles on the following pages included all those that fit the current MPC definition.

The CD-ROM Format Fray

There are a slew of other CD-ROM hardware and software formats vying for their rightful place in the market. Some of the software titles require a different type of hardware—often a CD-ROM drive sans computer.

Many of the titles that are available in MPC format will find their way to these other formats as well. It will be up to the users to buy the CD-ROM format that matches their hardware. Here is a brief listing of the variety of formats that are emerging.

CD-I Compact Disc Interactive. Developed by Philips, this uses a standalone machine that looks and acts very much like a conventional CD audio player. There is no computer required; instead, it runs with a television. One of the best CD-I titles is Time-Life 35mm Photography, which helps you learn how to take better photographs through a series of interactive lessons.

CD-ROM XA CD-ROM Extended Architecture. Used in both the Sony and IBM Ultimedia, it's starting to catch on as a format for standalone CD-ROM drives. It goes beyond the MPC format to support the interleaving of audio and data information.

Kodak Photo CD A file format for high-resolution photographic images. It is a variant of CD-ROM XA that supports multiple writing sessions so that you can append images to the end of a CD-ROM disk. The disks will be mastered in appropriately equipped photo finishing; end users will be able to play back photographic images, and with the proper software they can display, edit, and print the images.

MMCD Multimedia CD-ROM. Developed by Sony for use with its portable Multimedia Player, the MMCD format is based on the CD-ROM XA specification, which Sony developed with Microsoft and Philips, but it is not part of the MPC specification. Compton's MultiMedia Encyclopedia is a popular MMCD application.

Modular Windows Modular Windows is a scaled-down version of Microsoft Windows that requires less memory for playback than conventional Windows. In addition, it has the capability to support a variety of hand-held pointing devices; this makes it a good operating system for a new class of home-entertainment centers that will use your television as a display. The first of the Modular Windows machines announced is Tandy's VIS system, which will be sold by Memorex as the Memorex MD-2500.

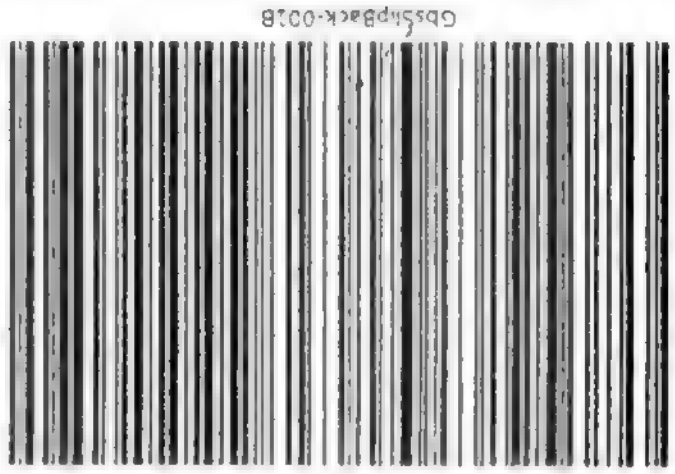
Ultimedia The standard for IBM's Multimedia Personal Systems, which include IBM's multimedia PC with a built-in CD-ROM XA–compatible drive (see *CD-ROM XA*).

COMPANY	TITLE	DESCRIPTION	PRICE
Compton's New Media (continued)	Guinness MultiMedia Disc of Records 1992	Over 7,000 world records, 300 color pictures, and 70 sounds. Uses SmarTrieve to conduct searches.	$59.95
	Jazz: A Multimedia History	Jazz history from originators to contemporary artists. Photos, sound effects, and music from 1923 to 1991. Quotes, interviews, and audio CD recordings.	$99.95
Context Systems Inc. The Technology Center, 333 Byberry Rd., Hatboro, PA 19040; 215-675-5000	Our House, featuring The Family Circus	Instructional entertainment disk intended to teach children the basics of how everyday objects work, from toasters to faucets. Includes explanations about how things were done throughout history before modern conveniences.	$69.95
Corel Systems 1600 Carling Ave., Ottawa, Ontario, Canada K1Z8R7; 800-836-3729, 613-728-8200	Corel Artshow '91 Corel Artshow '92	Corel Systems sponsors an annual contest of the best art created with CorelDRAW. This disk lets you view the contestants and see the winners. The coffee-table book version is included with the CD-ROM.	$99.00 each
Creative Multimedia Corp. 514 NW 11th Ave., #203, Portland, OR 97209; 503-241-4351	Beyond the Wall of Stars	Based on the series Choose Your Own Adventure, by R.A. Montgomery. 3-D animation, images, sound, and text. An electronic bookmark holds your place.	$49.99
	The Family Doctor	2,000 most commonly asked medical questions. Listing of 1,600 prescription drugs. Illustrated anatomy. Listing of support groups.	$79.99
Dr. T's Music Software Inc. 124 Crescent Rd., #3, Needham, MA 02192; 800-989-6434, 617-455-1454	Composer Quest *	Learn about the times surrounding important composers and painters throughout history, from the 15th century to the 20th century. Includes 60 musical performances, plus biographies, news events, an index to search by artist, trivia questions, a quiz, and on-line help.	$99.00
Ebook Inc. 32970 Alvarado-Niles Rd., #704, Union City, CA 94587; 510-429-1331	A Christmas Carol	Dickens's classic, illustrated by Arthur Rackham; includes interactive music, sound, and graphics.	$24.95
	Don Quixote	Multimedia storybook of Cervantes's masterpiece.	$49.95
	Renaissance Masters I *	Italian painting, sculpture, and architecture from the late Gothic to the early Renaissance. Over 1,300 images and over 1,000 subjects.	$99.95
	Goferwinkel's Adventures	Multimedia comic book. Follow and guide the hero Goferwinkel through Lavender Land using interactive panel art, music, speech, sound effects, and animation.	$49.95
	The Sleeping Beauty	Story can be read, heard, seen, or any combination of the three. Highlights text as story is read. Difficult words are highlighted and defined. Animation, sounds, and 20 minutes of original music.	$49.95
	The Star Child	Oscar Wilde's children's story brought to multimedia. Includes dictionary link and musical note buttons.	$49.95
	Twelve Roads to Gettysburg	See the history of the Battle of Gettysburg come to life in animated maps, biographies, sketches, photos, and illustrations.	$69.95
	The White Horse Child	Multimedia storybook by writer Greg Bear. Illustrations and music tell the story of a young boy's encounter with his own imagination. Includes a video of the author speaking of the story and creativity.	$49.95
Eduquest 6300 Shoup, #9, Woodland Hills, CA 91367; 818-992-8484	National Parks: The Multimedia Family Guide	Contains all the national parks, monuments, scenic trails, seashores, and so on. Includes 40 videos, 400 photographs, audio, and numerous information screens (highlights, kids' stuff, recommended lengths of stay, and days and hours of operation).	$59.95
Grolier Electronic Publishing Inc. Sherman Turnpike, Danbury, CT 06816; 800-356-5590, 203-797-3803	New Grolier Multimedia Encyclopedia *	Includes 33,000 articles, 3,000 full-color and black-and-white illustrations and photos, animated segments, a time line that links directly to articles, and "The Knowledge Tree," which allows searches of broad categories before branching to specific topics.	$395.00
HyperGlot Software Co. Inc. P.O. Box 10746, Knoxville, TN 37939-0746; 800-726-5087, 615-558-8270	Berlitz: Think & Talk French *	50 lessons that teach French (German, Italian, and Spanish versions are available also). Includes a 10,000-word bilingual dictionary. Comes on six to eight disks.	$199.00
	Learn to Speak Spanish	Covers two to three years of high school foreign-language lessons. 30 lessons using ongoing narrative about a man who moves to Mexico. Comes on two disks.	$99.00

* Reviewed in this issue.

Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side

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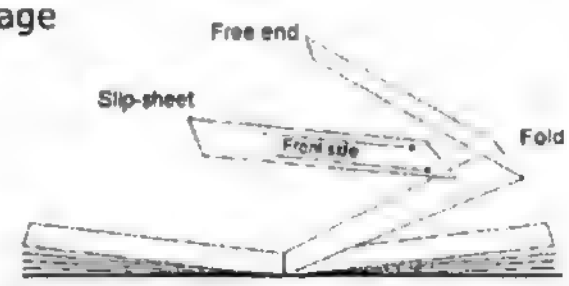
GbsSlipSheet-001

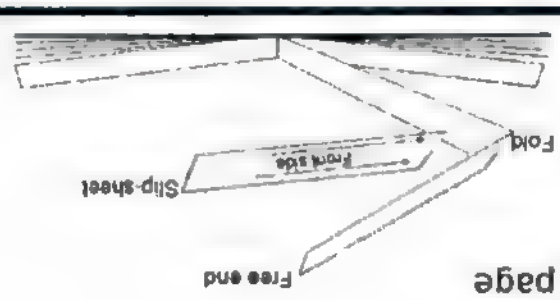
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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CD-ROMs for Your Multimedia PC

COMPANY	TITLE	DESCRIPTION	PRICE
Applied Optical Media Corp. 1450 Boot Rd., Bldg. 400, West Chester, PA 19380; 215-429-3701	American Vista	Atlas of the U.S. Over 600MB of information: topographical maps; resource and industry maps from Hammond; searchable data from the 1990 U.S. census; regional speech and music from the Smithsonian Institution; pictures, flags, and license plates from all the states.	$79.95
	Atlas of U.S. Presidents	All 41 U.S. presidents. Portraits, searchable facts, biographies of each president and first lady, and election results. Audio tracks of speeches.	$39.95
	Mediasource: General Topics Library, Volume 1	1,500 images and 90 minutes of background music in a broad range of topics and styles. Intended for use with multimedia presentations.	$395.00
	Mediasource: General Topics Library, Volume 2	Second in the series of photos and background music.	$395.00
	Mediasource: Historical Library, Volume 1	Drawings, photos, and information relating to significant events and personalities from antiquity to World War I; music and sound effects.	$395.00
	Mediasource: Natural Sciences Library	All the sciences from anatomy to zoology. Includes sections on weather and climate, nutrition, and environmental science.	$395.00
	The Multimedia Animal Encyclopedia	Collected by the British Museum and the University of London. Full-color illustrations, sounds, physiologies, habitats, behaviors, and conservation statuses of almost 2,000 animals.	$79.95
	World Vista	World atlas; includes republics of the Commonwealth of Independent States. Maps from Rand McNally, music from the Smithsonian Institution, information and phrases in different languages.	$79.95
Aris Entertainment 4444 Via Marine, #811, Marina del Ray, CA 90292; 310-821-0234	Business Background	Clip art for business reports and presentations. Includes music, sound effects, and 25 movies.	$39.95
	Full Bloom	Clip-art flowers for backdrops and presentations. Includes videos of flowers opening and classical piano audio tracks.	$39.95
	Island Designs	Two-disk clip-art set of Hawaiian images and sounds. Hawaiian shirt patterns and 100 sound tracks of early Hawaiian music. Also includes Batik designs; highlights fabrics from Bali and Balinese music.	$39.95
	Jets and Props	Two-disk set of civilian and military aircraft. 100 jets and 100 props. Short descriptions and 50 videos.	$59.95
	Majestic Places	Clip art of famous landscape photographs. Includes 100 photos and an original score of contemporary music.	$39.95
	Money, Money, Money!	Clip art of U.S. and international coins and currency, with 25 videos of money hot off the press. For business and education.	$39.95
	MPC Wizard	A variety of diagnostic tests for video and sound on your MPC. Also includes Best of Aris Media Clips—50 images and 50 sounds.	$14.95
	Wild Places	Clip art of North American landscape photography. Includes 50 originally composed New Age sound tracks by Joyce Imbesi.	$39.95
	World View	Clip art of space photos taken from NASA's archives. Educational descriptions, 25 movies, and 100 New Age music tracks.	$39.95
Broderbund Software Inc. 500 Redwood Blvd., P.O. Box 6121, Novato, CA 94948-6121; 800-521-6263, 415-382-4400	Arthur's Teacher Trouble	Interactive children's book by Marc Brown. Animated pictures and text about Arthur's experiences in third grade. Plays in English or Spanish with spelling words in each language. Ages 6 to 10.	$49.95
	Just Grandma and Me *	Interactive children's book. Music, sound effects, and talking characters. Hear the story in English, Japanese, or Spanish on one disk.	$49.95
Bureau Development Inc. 141 New Rd., Parsippany, NJ 07054; 800-828-4766, 201-808-2700	Great Literature Personal Library Series *	1,896 literary works. Color pictures, spoken passages, period music, and the ability to search topics, phrases, and themes.	$99.00
	The 1992 CIA Multimedia World Fact Book	248 country profiles taken from declassified CIA information. Includes maps from Hammond and performances of anthems. Extensive information on each country. Users of old disk can upgrade for $49.	$99.00
Compton's New Media 2320 Camino Vida Roble, Carlsbad, CA 92009; 800-532-3766, 619-929-2500	Compton's Interactive Encyclopedia	All the features of Compton's MultiMedia Encyclopedia. Includes Webster's Ninth New Collegiate Dictionary, Virtual Workspace, and a SmartTree retrieval engine.	$395.00
	Compton's MultiMedia Encyclopedia for Windows*	A 26-volume series that includes 9 million words; 32,000 articles; 13,000 images, maps, and graphs; and 60 minutes of music, speech, and sound effects.	$695.00

* Reviewed in this issue.

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Total Baseball	Total Baseball
The Family Doctor	The Family Doctor
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The Software Toolworks™ Reference Library	Discis Books™ Aesop's Fables
Bureau Development Inc., Best of the Bureau™	The Manhole™ CD-ROM
Ultima VI The False Prophet/ Wing Commander™	Bureau Development Inc., Best of the Bureau™

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A COMPLETE LISTING

CD-ROMs for Your Multimedia PC

COMPANY	TITLE	DESCRIPTION	PRICE
Interoptica Limited 300 Montgomery St., 2nd floor, San Francisco, CA 94104; 415-788-8788	Great Cities of the World, Volume 1 Great Cities of the World, Volume 2	Ten of the world's most famous cities on each disk. Narrative explanations of the major sights in each city, 20 phrases to help your travels, and fast facts on transportation, hotels, and so on. Two hours of audio, 300 maps, and 300 photos. Text equivalent to ten travel books.	$79.95 each
	Great Wonders of the World, Volume 1 *	Ten famous man-made structures. Time lines, text, maps, glossaries, a multimedia quiz, 200 photos, 200 illustrations, 100 maps, 30 animation sequences, and 40 minutes of motion video.	$79.95
Interplay Productions Inc. 3710 S. Susan, #100, Santa Ana, CA 92704; 800-969-4263, 714-553-6655	Battle Chess Enhanced CD-ROM *	Pieces come to life when moved. 30-minute animated tutorial. Opening-move library contains 30,000 moves. Ten levels of play. Modem capability.	$79.95
Killer Tracks 6534 Sunset Blvd., Hollywood, CA 90028; 800-877-0078, 213-957-4455	Killer Tracks Multimedia Series	Three CD-ROMs of music produced as a resource for multimedia computer productions. Categories: sales, training, and education. Each disk contains subcategories such as rock, mellow, and New Age and production elements such as bridges.	$150.00 each; set of three, $400.00
Macmillan New Media 124 Mt. Auburn St., Cambridge, MA 02138; 617-661-2955	Macmillan Dictionary for Children *	Zak is your icon guide through this 12,000-entry dictionary, which includes 1,000 illustrations, 400 sound effects, and easy-to-use guides and help.	$59.95
Macromedia Inc. 600 Townsend, San Francisco, CA 94103: 415-442-0200, 800-288-4797	Business and Technology, ClipMedia 1	The clip art of multimedia. Business and Technology, ClipMedia 1, takes images and sounds from business and technology to incorporate into your multimedia productions without royalties or licensing fees.	$395.00
	Industry At Work, ClipMedia 2	Second in the series.	$295.00
Metatec 7001 Discovery Blvd., Dublin, OH 43017; 800-637-3472, 614-761-2000	Nautilus	Monthly multimedia publication includes software, shareware, games, demos, and commentary. Shipping and handling not included in subscription price.	$119.40
	Back Pack	Trial subscription of six back issues of Nautilus. Includes six CD-ROM issues plus a coupon for a seventh CD-ROM free.	$69.95
Microsoft Corp. One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080	Microsoft Bookshelf, 1992 Multimedia Edition *	Includes an encyclopedia, the American Heritage Dictionary, Bartlett's Familiar Quotations, the Concise Columbia Dictionary of Quotations, the Hammond Atlas of the World, Roget's II: The New Thesarus, and The World Almanac and Book of Facts. Also available as integrated software bundled with Microsoft Word for $595.	$195.00
	Cinemania *	19,000 movie reviews from 1914 to 1991, biographies of actors, directors, and producers, movie stills, classic dialogs, and a listing of Academy Award winners.	$79.95
	Microsoft Encarta	Multimedia encyclopedia. Includes articles, animation, sound, illustrations, graphs, photographs, an atlas, and a dictionary.	$395.00
	Multimedia Beethoven: The Ninth Symphony *	Enables you to explore any section of the music. Includes background on Beethoven's life, an in-depth look at the musical architecture of the symphony, and a glossary of 130 terms.	$79.95
The Music Bank P.O. Box 3150, Saratoga, NY 95070; 408-867-4756	Stingers	98 clips of music in multiple computer formats as well as audio CD format. Designed to enhance multimedia presentations using small amounts of disk space. Most clips are under 10 seconds and can be easily looped.	$99.00
Music Pen Inc. 55 W. 16th St., #3, New York, NY 10011; 212-807-9608	Lenny's Room	Follow Lenny the Penguin in his interactive animated world. Includes games, puzzles, and audio CD recordings of sounds and music. Ages 8 to adult. Music learning software.	$79.95
Presentation Graphics Group 270 N. Cannon Dr., #103, Beverly Hills, CA 90210; 800-468-9008, 310-277-3050	Digisound Sound Solution Disc	Over 1,000 sound effect and music tracks. 200 fully licensed music tracks on MIDI. Each tracks in multiple lengths and a loopable version. 450 sound and music effects in different categories. 350 DigiVoice tracks sampled at 22 kHz.	$249.00

* Reviewed in this issue.

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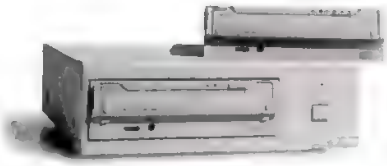

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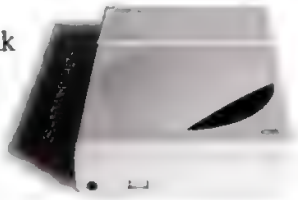

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Sierra On-Line P.O. Box 485, Coarsegold, CA 93614; 800-326-6654, 209-683-4468	Jones in the Fast Lane	A parlor game for the nineties. One to four players, each with a different musical theme song, travel the board of life. Computer graphics and stereo sound track.	$69.95
	King's Quest V *	Role-playing game on-screen. Interactive movie adventure game.	$69.95
	Mixed Up Mother Goose *	Multimedia picture book requires no reading skills. Serves as an introduction to computers and foreign languages for children.	$69.95
	Space Quest IV	Space adventure of excitement and comedy. High-resolution graphics and stereo sound track.	$69.95
The Software Toolworks 60 Leveroni Ct., Novato, CA 94949; 415-883-3000	The Animals	Designed to create the zoo experience of the 21st century. Explore the 225 animals using 1,500 photos, more than 100 pages of information, 150 video clips, and 12 narrated stories that create an integrated explanation of the animals and their environments.	$119.95
	Chessmaster 3000 Multimedia	For beginners and experts. Includes audio advice and an analysis of your game. A reference and teaching tool that can be viewed in a variety of displays.	$99.95
	Mavis Beacon Teaches Typing!, Version 2.0 MPC	Typing tutor that talks to you. Voice analysis/instruction, ten dictation exercises, and a self-running demonstration.	$99.95
	Software Toolworks US Atlas MPC	Feature-rich atlas. Allows you to place icons and make notes on maps for reference. Copy and paste to other programs and print.	$149.95
	Software Toolworks World Atlas MPC *	4,400 statistical maps, comparison graphs, comprehensive city data, pronunciation of names, animated flags, and audio anthems.	$149.00
Sound Ideas 105 W. Beaver Creek Rd., #4, Richmond Hill, Ontario, Canada L4B1C6; 800-387-3030, 416-868-5000	Sound Effects	Over 300 digitally recorded sound effects on one disk. Recorded in multiple computer data storage modes, as well as Red Book audio to be played on an audio CD player.	$75.00
Syracuse Language Systems 719 E. Genesee St., Syracuse, NY 13210; 315-478-6729	Playing with Language Series	Available in English, French, German, and Spanish. Introductory game disks designed to teach a foreign language. 27 vocabulary and grammar games to expose users to over 200 words and phrases. Designed for ages 4 and up.	$69.95
Texas Caviar Inc. 3933 Steck Ave., Suite B-115, Austin, TX 78759; 512-346-7887	Annabel's Dream of Ancient Egypt *	Instructional entertainment. Story of a cat, set in Egypt, to music from Verdi's *Aïda*.	$85.00
	Vital Signs: The Good Health Resource *	Bilingual consumer health reference. Health database, directory of toll-free information lines, risk-reduction exercises, and learning activities.	$95.00
	Whale of a Tale	Introduction to reading and history, using a whale and his friends.	$89.95
Tiger Media 5801 E. Slauson Ave., #200, Los Angeles, CA 90040; 213-721-8282	Murder Makes Strange Deadfellows	Haunted-house mystery disk.	$59.95
The Voyager Company 1351 Pacific Coast Hwy., Santa Monica, CA 90401; 800-446-2001, 310-451-1383	Amanda Stories	Ten different interactive stories by Amanda Goodenough. No reading is required to follow the stories of Inigo the Cat and Your Faithful Camel. For ages 3 and up.	$59.95
Warner New Media 3500 W. Olive Ave., #1050, Burbank, CA 91505; 800-593-6334, 818-955-9999	Desert Storm: The War in the Persian Gulf	Re-creation of the story as it unfolded, recorded by *TIME* correspondents. Files, audio reports/interviews, and photos organized in chronological order and by subject matter.	$49.99

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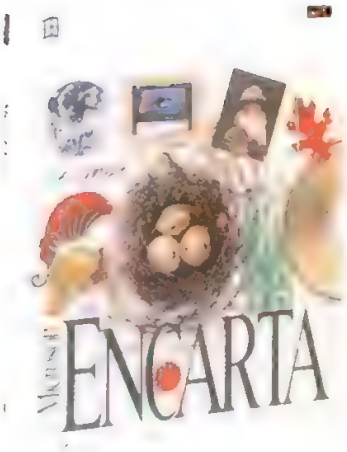
The Multimedia Encyclopedia



Where typical encyclopedias end, Microsoft Encarta multimedia encyclopedia begins. Encarta brings learning to life with the combination of words, images, animation and live sounds that work together to create a new fascinating universe of knowledge right at your fingertips! Encarta isn't just a book loaded into your computer but a new kind of reference tool that uses advance technology to transform all the features of multimedia into a stunning new world of knowledge. You will be amazed at the wealth of information you will find. The complete 29 volume set of 1992 Funk & Wagnalls New Encyclopedia, plus more than 1000 new articles written exclusively for Microsoft Encarta. Find the joys of learning today!

Cinemania
Explore the magic behind the movies! Contemporary to classic films, Cinemania is the fun way to see and hear it all-the reviews and biographies, the faces and voices, the inside stories. For every movie lover, it's an incredible new view of the movies.
MEDIA CD-ROM
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Multimedia Beethoven
Experience the master's famous symphony like never before. With a click of the mouse, you can compare musical themes, hear selected orchestral instruments, see a symphonic score come alive on screen, and far more. It's an incredible performance you'll never forget.
$49

Bookshelf
It's the illustrated, animated, talking reference library for home, office, or school. Microsoft Bookshelf brings the excitement of sight and sound to seven of the most popular reference books. For business, it's essential.
MEDIA CD-ROM
$119

Let the Timeline feature of **Encarta** *give you an amazing overview of epochs, civilizations, and events. When a subject interests you, just click it to find out more.*

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composer and his Ninth Symphony. You'll appreciate this symphony in ways you never thought possible; each of the program's six sections focuses on an aspect of the man and his composition.

The Art of Listening, for example, presents the fine points of music appreciation in general and as it pertains to this symphony. Musical examples illustrate concepts and terminology; you are encouraged to interact with the lessons by selecting and listening to appropriate passages, some performed to highlight certain musical themes and concepts. Another section plays the entire symphony (with Red Book audio), along with on-screen commentary about the music's structure. There's a biography section for history buffs and a quiz/game for those who like their knowledge tested.

Multimedia Beethoven: The Ninth Symphony
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400.
List price: $79.95.
Requires: 286-based PC or better, 2MB RAM, CD-ROM drive, VGA monitor, sound board, DOS 3.1 or later, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, headphones or speakers, mouse.
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24. Renaissance Masters I

Renaissance Masters I is a collection of paintings, drawings, sculptures, and architecture from the early Renaissance. There are more than 1,300 works of art from masters such as Botticelli, da Vinci, Donatello, and Giotto. You can browse the works by title, school of art, medium, and artist. Each piece of art has a fact window that lists its title, artist, size, medium, and location. Using Windows commands, the beautifully photographed Super VGA images can be sized, arranged, and overlapped to make comparisons. Most works include a biography of the artist.

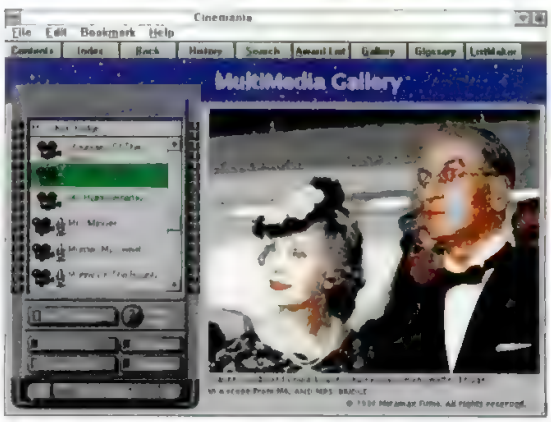
The user interface shows a thumbnail sketch of each work as you flip through selections, or you can opt to browse the collection 15 at a time using a gallery of sketches. Retrieval and screen painting are noticeably faster than in earlier versions. There are very few sound clips, no animation, and no interpretative captions for the art, but you'll still enjoy it.

Renaissance Masters I
Ebook Inc., 32970 Alvarado-Niles Rd., #704, Union City, CA 94587; 510-429-1331.
List price: $99.95.
Requires: 4MB RAM, CD-ROM drive, Super VGA monitor, Microsoft Windows 3.0 with Multimedia Extensions or Windows 3.1 or later, sound board, headphones or speakers, mouse.
Circle 519 on reader service card

25. Variety's Video Directory Plus

Where else but on CD-ROM can you get 75,000 video listings, from Army training films to the latest Hollywood releases? Films are classified into over 500 subjects, from aging to yoga.

Originally developed for and sold to video dealers and retailers as an annual subscription, popular demand brought the single issues that are available to the general public. Since it's not a multimedia title, there are no pretty pictures or sound bites. Most videos have only a single-sentence synopsis; the 2,500 most recent hits rate a full paragraph. The search engine is quick and easy to use, although it lacks the polish of a consumer product. Depth of subject makes this a four-star CD-ROM for the hardcore film addict.



With over 19,000 movie reviews (spanning films made from 1914 through 1991), Cinemania is the movie buff's dream.

Variety's Video Directory Plus
Bowker Electronic Publishing, 121 Chanlon Rd., New Providence, NJ 07974; 800-323-3288.
List price: $195; yearly subscription with quarterly updates, $395 plus $20 shipping.
Requires: 640K RAM, CD-ROM drive, DOS 3.0 or later.
Circle 520 on reader service card

The Worlds Around Us

CD-ROMs let you conduct an intense field study of subjects such as astronomy and nature without leaving your PC.

26. Distant Suns

Distant Suns puts a planetarium in your PC. This is not a full multimedia product that incorporates sound and animation, but rather, it uses the capacity of the disk to store more than 1,500 high-resolution photographs of planets, asteroids, and other celestial bodies, many taken from NASA space probes. Double-clicking on a body opens a fact file with a link to this photographic database. By entering the latitude and longitude of your position and setting a date (from 4000 B.C. to A.D. 10,000) and time, you get an exact view of the sky from your own home in any direction. Distant Suns also lets you fix heavenly bodies at the center of the screen as references for star sightings.

Distant Suns
Virtual Reality Laboratories Inc., 2341 Ganador Ct., San Luis Obispo, CA 93401; 805-545-8515.
List price: $149.95.
Requires: 4MB RAM, CD-ROM drive, VGA monitor, DOS 5.0, Microsoft Windows 3.1 or later, mouse.
Circle 521 on reader service card

27. Mammals: A Multimedia Encyclopedia

With over 200 different mammals, 700 color photographs, 600 pages of text, 155 animal vocalizations, and 45 full-motion video clips, Mammals is "Wild Kingdom" on a disk. One of the first multimedia CD-ROMs with mass appeal, Mammals has begun to show its age; still, this disk from IBM and National Geographic remains a classic for nature lovers. □

Mammals: A Multimedia Encyclopedia
National Geographic Society Educational Services, Washington D.C. 20036; 800-368-2728.
List price: $150.
Requires: 640K RAM, CD-ROM drive with left and right audio, VGA monitor, sound board, DOS 3.3 or later, headphones or speakers, mouse.
Circle 522 on reader service card

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CA-Simply Accounting Win/DOS 109
Chipsoft Turbo Tax DOS/Win 46
Dacoasy Accounting v4.3 89
Intuit QuickBooks (Special) 89
Intuit Quicken Win (Special) 42
MECCA Mangoging Your Money v9.0 49
Microsoft Money 41
Peachtree Complete v6.0 169
Reality Tech Wealthstarter v2.0 33

Bus. Graphics

Aldus Persuation v2.1 Windows 325
CA-Cricket Presents (Special) 109
Lotus Freelance Graphics v4.0 299
Microsoft Powerpoint 289
Micrografix Windows Draw 95
Power-Up! Calendar Creator Plus v4.0 36
SW Pub. Harv. Graph for Win v1.01 349
SW Publishing Harvard Graphics v3.0 389

CAD

American Design CAD v4.0 3D 229
American Design CAD v5.0 2D 159
Autodesk Autosketch v3.0 (Special) 140
Autodesk Generic CAD v6.0 269
Foresight Drafix Cad Ultra v4.2 (Special) 245

Communications

Datastorm Procomm Plus for Windows 79
Datastorm Procomm Plus v2.01 69
Everex Evercom 24 Int (Special) 65
Hayes Optima 24/SCEZ (Special) 119
Hayes Optima 96/SCEZ (Special) 329
Hayes Smartmodem 24/SCEZ 249
Hayes Ultra 96/SCEZ v.42 Bis 549
Intel Satisfaxtion 14.4 Fax/Data (Special) 399
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U.S. Robotics Courier v32BIS 14.4 EXTL 559
U.S. Rob. Courier v32BIS 14.4 Fax EXTL 569
Zoom 2400BPS w/RPI Hrdwr EXTL 59

Database

Approach for Windows v1.0 (Special) 239
Borland dBASE III Plus v1.1 459
Borland dBASE IV v1.5 485
Borland Paradox v4.0 519
Fox Pro v2.0 DOS 6-Pack (Special) 549
Lotus Organizer 89
Microsoft Access ....Call
Microsoft Fox Pro Win ....Call
Microrim R BASE v3.1 429
SuperBase IV Windows v1.3 429
Symantec Q&A v4.0 (Special) 249
Word's Tech Arago Prof. 599

Desktop Publishing

Adobe Illustrator v4.0 349
Adobe Type Fonts (Special) ....Call
Adobe Type Manager Plus Pk 119
Aldus Freehand Win v3.1 389
Aldus Gallery Effects Win 129
Aldus Pagemaker v4.0 Win (Special) 478
Aldus PhotoStyler Win v1.1A 499
Caere Omnipage Pro Win v2.1 599
Contact ACT v2.1 Single User 209
Corel Draw v3.0 Dsk & CD (Special) 379
Corel Draw v3.0 comp upgrade 125
Microsoft Publisher for Win V 123
Microsoft True Type Fonts Pack (Special) 49
Microsoft Word for Win v2.0 289
Z Soft PC Paintbrush 5+ 89

Home/Recreation

Accolade Hardball III (Special) 32
Accolade Jack Nicklaus Signature Ed. 37
Broderbund Kid Pix (Special) 33
Broderbund New Print Shop Companion 29
Broderbund Where in Time 29
Davidson & Assoc New Math Blaster Plus 29
Individual Software Prof Windows v3.1 29
Mecc The Oregon Trail 29
Mecc Word Munchers (Special) 15
Microprose Civilization Master Ed. 42
Microsoft Golf/Win 41
Microsoft Ent Pack IV 27
Microsoft Flight Simulator v4.0 37
Origin Sys. Ultima VII 44
Sierra On-Line Kings Quest V 39
SMC Automap (Special) 46
SMC Automap Europe 79
SMC Orbits (Special) 39
Softsync Expert Home Design 10
Walt Disney Bundle 35

Integrated

CA-Simply Business (Special) 399
Lotus Smart Suite/Upgrade 449/339
Lotus Works 89
Microsoft Office v3.0 339
Microsoft Works for Win v2.0 119
Microsoft Works DOS v2.0 (Special) 90
Spinnaker PFS First Choice v3.1 89

Operating Sys.

Digital DR DOS v6.0 (Special) 68
IBM OS/2 v2.0/Upgrade 99
Microsoft DOS v6.0 upgrade 59
Microsoft Win. 3.1/Upgrade 88/47
Microsoft Win. for Workgroups (New) 149
Microsoft Win/Workgrps Add-On (New) 149
Novell Netware Lite v1.1 65
Qualitas 386 Max v6.0 (Special) 59
Qualitas BlueMAX v6.0 79
Quarterdeck Desqview 386 v2.4 119
Quarterdeck QEMM 386 Mem Mgr v6.0 57

Programming

Borland C++ v3.1 w/App Fram v3.0 489
Borland Turbo C++ for Windows v3.1 99
Borland Turbo Pascal v6.0 99
CA-Clipper v.501 (Special) 469
Microsoft C Compiler v6.0 299
Microsoft Fortran Compiler v5.1 289
Microsoft Visual Basic (Special) 119
Symantec Zortech C++ 419

Spreadsheets

Borland Quattro Pro Win/DOS Combo 299
Borland Quattro Pro v4.0 Comp Upgrade 89
CA-Supercalc v5.1 (Special) 89
CA-Superproject v2.1 (Special) 499
Lotus 1-2-3 for Win v1.1 Comp Upgrade 95
Lotus 1-2-3 for Windows v1.1 289
Lotus 1-2-3 v3.1+ 389
Microsoft Excel for Win Upgrade v4.0 92
Microsoft Excel v4.0 for Win 295

Utilities

Berkley Star Trek Screen Saver 42
Berkley Syst After Dark for Win v2.0 27
Central Pt.PC Tools 7.1 Anti-Virus 149

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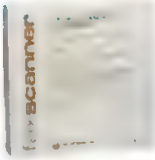

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Utilities

Central Pt PC Tools v7.1 115
Central Pt.PC Tools Delux Lan 10pk v7.1 785
FGS Direct Access Win v1.0 59
Gold Disk Screen Craze 19
HP Dashboard Windows 42
Star Software Stacker A" 16 179
Star Software Stacker v2.0 79
Symantec Norton Antivirus v2.0 79
Symantec Norton Desktop for Win v2.0 117
Symantec Norton Utilities v6.01 110

Word Processing

Individual Software Resumemaker 29
Lotus Ami Pro v3.0 Upgrades 89
Lotus AmiPro v3.0 & v2.3 w/ for Win 189
Microsoft Word for Win v2.0 289
Que Soft Rightwriter for Win v5.0 59
Reference Grammatik 5 DOS or Win 53
Software Pub. Corp. Pro Write v2.2 169
Wordperfect for Win v5.1 259
WordPerfect v5.1+Fileserver 265

Accessories

Kensington Masterpiece (Special) 89
Log tech Dexxa Mse w 9 25 Pin Adapter 19
Log tech Mousetrap Bus 69
Log tech Trackman Portable 95
Microsoft Ball Point Mouse 114
Microsoft Bus Mse w Win Ser PS/2 Bus 147

CPU's

ALR PowerFLEX 386SX 25MHz 789
AST Premium 386SX/25/80 1699
PS/2 ....Call
Wyse 3010SX/C 1.2 Meg 5.25" 639
Wyse Decision 386SX 20 mhz no drive 659

Connectivity

3 Com Ethernlink III TP Adapter 215
Eagle NE1000 Ethnt Crd 8bit no Cbl 94
Eagle NE2000 Ethnt Crd 16bit no Cbl 169
Stand Micro Ethercard Elite 16 Combo 215
Stand Micro Sys Ethercard PlusElite 16T 179

Monitors

Goldstar 1460 Plus 14" 289
Magnavox Super VGA 14" 28 309
NEC Mult Sync 3FGX Flat Screen 15" 659
NEC Mult Sync 2A 14" Super VGA 399
NEC MultSync 4FG Flat Screen 15" 759
Packard Bell PB8539VG 14" VGA 239
Samsung ML4571 14" VGA White 119
Samsung Syncmaster 4 17" Super VGA 759
Wyse Tech. Wyse 50 14" Terminal w/o Kbd
Am/Gray/Wht 289
Wyse Tech. Wyse60 14" Terminal w/o Kbd
Am/Gray/Wht 299

Multimedia

Creative Labs Int CD-Rom Soundblaster Pro MS
Win 3.1 Speakers Model 200 459
Creative Labs Ext CD Rom Soundblaster Pro MS
Win 3.1 Speakers Model 200 519
Lab Tech Stereo Speakers 100 16
Lab Tech Stereo Speakers 200 19
Sound Blaster(Mono) Joystick port MIDI 95
Sound Blaster Stereo Joystick port MIDI 189
Sound Blaster MIDI Kit 59

Storage/Drivers

Creative Labs CD-ROM Kit Int 359
Creative Labs CD ROM Kit Ext 439
Colorado Mem Systems Jumbo 250 MB 259
Magnavox CM205XBK CD Rom 359
Magnavox CM205XRS CD w Grayer Enc 379
Microsoft Soundboard ....Call
NEC CDR 84 FS2 MPC 599
Seagate ST3144A 130MB 3.5 IDE 289
Syquest 88MB Internal Removable Cart 519
TEAC 3.5" 1.44MB Floppy Disk Drive 59
TEAC 5.25" 1.2MB Floppy Disk Drive 59
Toshiba 1.2MB 5.25 Floppy 69

Printers/Scanners

Canon BJ 10EX Grey Wht 319
Canon BJ300 80 Col 24 Wire 429
HP Deskjet 500C 739
HP IV 1459
HP IIP 1159
HP IIP w/Postscript 1699
HP IIP Plus 849
HP Scanner PC AT or MCA 1499
HP Scanner PC AT or MCA 1239
Kodak Diconix 180si Printer Par, Ser 289
Kodak Diconix 4 color Printer 569
LaserMaster Winjet 300 369
LaserMaster Winjet 600 3345
LaserMaster Winjet 800 579
LaserMaster WinPrinter 800 1269
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Logitech Scanman 32 125
Logitech Scanman 32 w/ Catchword 139
Okidata ML320 Printer 309
Okidata ML380 Printer 219
Okidata OL400 Printer 549*
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CIRCLE 219 ON READER SERVICE CARD

DOSKEY Macro Tips

BY NEIL J. RUBENKING

CREATING A DVORAK KEYBOARD

DVORAK.SCR (Figure 1) produces a memory-resident utility requiring only 112 bytes of RAM. When installed, the utility enables the Dvorak keyboard layout shown in Figure 2. When Scroll Lock is OFF, the Dvorak layout is active. When Scroll Lock is ON, the QWERTY layout is active.

DVORAK.COM makes use of interrupt 15h, service 4Fh, so computers with a BIOS older than January 1986 may not be able to use it. The program is intended for use with DOS; Windows already includes a Dvorak keyboard layout.

In all, 33 keys are translated. Note that there are minor Dvorak variants dealing with the quote, slash, and semicolon keys; you may find other Dvorak layouts that place these keys differently. Key redefinition programs that use interrupt 16h can be used with this program in their normal fashion.

Create DVORAK.SCR with an ASCII editor. Be sure to put a carriage return after the final Q and a blank line before the R CX line. To create the program, enter DEBUG < DVORAK.SCR at the DOS prompt, or you can download DVORAK.ZIP from the Utilities/Tips Forum on PC MagNet.

David M. Dibble
Riverside, California

▶PC MAGAZINE: There's a persistent rumor that the original purpose of the standard QWERTY keyboard layout was to prevent jammed keys by slowing down typists. Whether or not this is true, Dvorak aficionados insist that it speeds their typing by putting the most-used keys on the home row. DVORAK.COM lets you try this layout for yourself.

The author warns that computers with a BIOS date before January 1986 may not be able to use DVORAK.COM. If you don't know the date on your computer's BIOS, you can find out easily enough. Load DEBUG and enter the following command: D FFFF:5 L 8. The resulting line of information will include the BIOS date at the far right. Type Q and Enter to quit DEBUG.

DVORAK.SCR is a rather long DEBUG script, and presents many opportunities for error. You can catch any errors by creating DVORAK.COM with this command:

```
DEBUG < DVORAK.SCR > DVORAK.LOG
```

Now scan the .LOG file for the string 'Error. If the string appears, there was an error in the line above; fix it and try again. Only when DEBUG processes the script with no errors should you run the DVORAK program.

DVORAK.COM saves memory by disposing of its own copy of the DOS environment. But if you check your memory with DOS 5.0's MEM command or another memory-mapping utility, you'll see that DVORAK.COM takes 368 bytes (170 in hexadecimal), not 112. It's true that the program code takes only 112

▶ IN THIS SECTION

Tutor 373
Utilities 375
Environments 388
Power Programming 392
Solutions 408

DVORAK.SCR
Complete Listing

```
N DVORAK.COM
A 100
JMP 0168                    ;Jump to INITIALIZE
PUSHF                       ;**BEGIN  replace int 15h
CMP AH, 4F                  ;called by Int 9 to translate scan codes
JZ 0112                     ;if function 4Fh, jump TRANSLATE
POPF                        ;restore flags
JMP 010D                    ;jump ORIGINAL handler
POP BX                      ;DO_INT15
STC
JMP 0000:0000               ;ORIGINAL int 15h
POPF                        ;TRANSLATE
PUSH BX
PUSH DS
MOV BX, 0040
MOV DS, BX                  ;DS to BIOS data area
TEST BYTE PTR [0017],10     ;Scroll Lock on?
POP DS
JNZ 010B                    ;if on, use Qwerty keyboard.  Jump DO_INT15
MOV AH, AL                  ;scan code to AH
AND AH, 80                  ;save possible high bit, AH = 80h or 0
AND AL, 7F                  ;zero high bit
CMP AL, 0C                  ;scan code in range?
JB  0138                    ;  if not, jump BREAK
CMP AL, 35
JA  0138                    ;Jump if high range to BREAK
SUB AL, 0C                  ;set up AL as pointer
MOV BX, 013E                ;BX to address of KEY_LIST scan code table
CS:                         ;       key values 12 - 53 (decimal)
XLAT                        ;translate AL to new scan code. Key pressed.
OR AL, AH                   ;if BREAK, OR with 80h.  Key released
MOV AH, 4F                  ;restore function 4Fh
JMP 010B                    ;Jump DO_INT15.  KEY_LIST follows:
DB          1A  1B  0E  0F  28  33  34  19
DB  15  21  22  2E  13  26  35  0D  1C  1D
DB  1E  18  12  16  17  20  23  14  31  1F
DB  0C  29  2A  2B  27  10  24  25  2D  30
DB  32  11  2F  2C
MOV AX, 3515                ;INITIALIZE.  Above portion is TSR
INT 21
MOV [010E], BX              ;save original int 15h vectors
MOV [0110], ES
MOV AX, 2515                ;code to set interrupt
MOV DX, 0102                ;replacement int 15h address
INT 21
MOV AX, [002C]              ;environment block
MOV ES, AX
MOV AH, 49                  ;free our copy of environment
INT 21
MOV DX, 0192                ;load DX with SIGN_ON
MOV AH, 09                  ;display it
INT 21
MOV DX, 0168                ;DX to INITIALIZE, area to place in memory
INT 27                      ;go memory resident.  SIGN_ON follows:
DB  0D,0A,'DVORAK loaded.',0D,0A,24

R CX
A5
W
Q
```

Figure 1: **This DEBUG script generates a minuscule utility program that lets you choose between the regular QWERTY keyboard layout and the Dvorak layout.**

The Dvorak Keyboard

Figure 2: **The Dvorak keyboard layout supposedly promotes faster typing by putting the most often used keys on the home row.**

bytes, but the obligatory Program Segment Prefix adds another 256. Even at 368 bytes, it's amazingly tiny for what it does!

DOSKEY MACRO TIPS

The DOS 5.0 reference manual describes only a few of the tricks you can perform using DOSKEY macros. The manual indicates three ways, for instance, to execute ANSI escape sequences:

- using the PROMPT command
- using TYPE to display a text file containing the ANSI sequences
- using ECHO in a batch file

But it never suggests you can use a DOSKEY macro to execute ANSI escape sequences directly from the keyboard:

```
DOSKEY ESC=ECHO ^[[$*
```

Here, ^[represents the escape character. To use the macro, type ESC followed by any ANSI codes at the DOS prompt. Once you've installed the macro, for example, you could enter the following command to program the Home key to change to the root directory of drive C: and clear the screen

```
ESC 0;71;"c:";13;"
 cd\";13;"cls";13p
```

A variation of this lets you send escape codes to control your printer directly from the DOS prompt. First create the PESC macro by entering the line

```
DOSKEY PESC=ECHO
 ^[$*$GPRN
```

Then you can add the appropriate characters to accomplish your task. For example, the command

```
PESC4^N This is a test
```

would print "This is a test" in double-wide italics on a printer that uses Esc 4 for italics and Ctrl-N for double-wide printing.

By omitting the escape character from this macro definition you can also define a line-printing macro that will send anything you type after LP to the printer:

```
DOSKEY LP=ECHO $* $G PRN
```

Since you can't enter the escape character directly from the keyboard, you'll need to use a text editor to create a batch file that defines the macro. To enter an escape or other control character using DOS 5.0's EDIT.COM, first press Ctrl-P and then the special key. The escape character appears as a left arrow. Some control characters, like Ctrl-L, are intercepted by the DOS editor. To enter these, press Ctrl-P followed by Alt-*nn*, where *nn* is the ASCII code for the character. The following useful macro will eject a page from the printer when you type FF:

```
DOSKEY FF=ECHO ^L $G PRN
```

To enter ^L using the DOS editor, type Ctrl-P, then Alt-12.

Finally, if you use a lot of macros and can't remember them all, just add the following ANSI command to your macros batch file so you can press Page Down to see a list of the available macro commands:

```
ECHO^[[0;81;"DOSKEY
 /m|sort|more";13p
```

Here again, the ^[after ECHO represents the escape character.

Brian L. Zimmerman
El Paso, Texas

▶PC MAGAZINE DOSKEY macros are a little like batch files, but they have their own special abilities and limitations. The biggest limitation is that the entire macro must fit on a single 127-character command line, though within that line the $T special character can separate multiple commands. The strongest advantage is that DOSKEY macros are stored in memory, so they execute much faster than batch files. Also, even the smallest batch file takes one cluster (2K or more) of disk space, yet you can probably create all of your DOSKEY macros with a single batch file that's under 2K.

Another virtue of DOSKEY macros, one that I wish were available to batch files, is their ability to access the command line as a whole. Batch files can access individual command line elements using the replaceable parameters %1 through %9. DOSKEY macros use $1 through $9 for the same purpose, but the special character $* is replaced by *everything* that follows the macro name. The ESC, PESC, and LP macros above all use this special character. Note also that PESC and LP include the special character $G, which is replaced by the greater-than symbol when the macro runs.

The May 26, 1992, User-to-User column presented a BASIC program called SAVEMAC.BAS. Used in combination with a DOSKEY macro of the same name, this program creates LOADMAC.BAT, a batch file that recreates all active DOSKEY macros. When you're experimenting with various DOSKEY macros, it's handy to be able to save and restore them in this way. To create the four DOSKEY macros described above and redefine the PgDn key as well, just run the batch file MACROTIP.BAT shown in Figure 3 or download it from PC MagNet as MACROT.BAT. □

MACROTIP.BAT

Complete Listing

```
@ECHO OFF
REM ==== The ^[ in the next two lines
REM ==== represents the escape character.
DOSKEY ESC=ECHO ^[[$*
DOSKEY PESC=ECHO ^[$* $G PRN
DOSKEY LP=ECHO $* $G PRN
REM ==== The ^L in the next line
REM ==== represents the Ctrl-L character
DOSKEY FF=ECHO ^L $G PRN
REM ==== The ^[ in the next line represents
REM ==== the escape character.
ECHO ^[[0;81;"DOSKEY /m|sort|more";13p
```

Figure 3: **This batch file creates four handy DOSKEY macros, and redefines the Home key so it will list the available DOSKEY macros.**

Share your latest DOS and system discoveries through User-to-User. See the "How to Contact Us" sidebar in the Solutions column.

Locking and Unlocking Your Hard Disk

BY JEFF PROSISE

I frequently receive letters asking if a practical way exists to software-lock a hard disk so unauthorized persons can't access it. You can buy commercial disk-lock utilities for this purpose but, there's a simpler way that relies on a couple of small programs you can whip up with DEBUG. Understanding the method requires a bit of background, though.

When FDISK partitions a hard disk, it stores information in a 64-byte table called the *master partition table.* The table starts at offset 1BEh from the beginning of the first sector and holds four 16-byte entries, each corresponding to one partition on the disk. The fifth byte of every entry, the *system indicator byte,* identifies the operating system that owns the corresponding partition. A value of 0 means an unused partition; any other value is an operating system identifier. DOS uses 1, 4, and 6 to specify the size of its partitions, where 1 means less than 16MB, 4 denotes 16 to 32MB, and 6 identifies a large (greater than 32MB) partition. Extended DOS partitions—those containing logical drives not defined in the master partition table—are indicated with 5.

Under DOS, a primary partition can hold only one logical drive (C:). Defining additional logical drives (D:, E:, and so on) on the same hard disk requires that you create an extended DOS partition and subdivide it into the desired drives.

DOS scans the partition table at start up, assigning a drive letter to each valid partition it owns. Partitions with a system indicator byte of 0 are not assigned drive letters. If you attempt to access a partition that has no drive letter, you'll receive an "Invalid drive specification" message from DOS. Therefore, if you replace the system indicator byte for each partition with 0, DOS will cease to recognize your hard disk. This is reasonably easy to do with DEBUG directly. It's easier still with a short utility, LOCK.COM, and its companion program, UNLOCK.COM, which you can create using DEBUG. (Both programs can also be downloaded from the Utilities/Tips Forum on PC MagNet archived as HDLOCK.ZIP.) But first, the caveats:

- Only use LOCK on disks that were partitioned with FDISK. If you use a third-party disk utility that creates non-standard partition tables (such as Disk Manager) *do not* attempt the procedures described here. Doing so could render your hard disk permanently unreadable.
- Run UNLOCK.COM only on the PC used to create it. We'll cover the details below, but essentially, you adapt UNLOCK for a particular hard disk—your own—so using it on someone else's could make that disk unusable.
- If you ever repartition your hard disk, you must repeat the procedure for creating UNLOCK.COM after repartitioning is complete. This ensures that system indicator values that UNLOCK writes to the partition table reflect the new ones placed there by FDISK.
- Back up the files on your hard disk before using LOCK and UNLOCK for the first time. Then, if something goes wrong, you can repartition the drive with FDISK and restore the backed-up files.
- Be extremely careful when you type the DEBUG scripts shown here; mistakes could be fatal.

Prevent unauthorized people from accessing your hard disk with two small utilities you can create with DEBUG.

You need to do two things before generating LOCK.COM. First, create a bootable DOS floppy disk by inserting one in drive A: and typing FORMAT A: /S. Actually boot from it a time or two so you know that it works. If you run DOS 5.0, type MIRROR /PARTN to create a backup copy of the partition table on the floppy disk, just in case other efforts to revive the disk fail. Make sure you also copy the DOS 5.0 UNFORMAT.COM file to the diskette. UNFORMAT /PARTN will restore the partition table from the floppy disk.

Second, create the companion UNLOCK.COM and copy it to the bootable floppy disk *before* executing LOCK .COM. Running LOCK will zero out the master partition table's system indicator bytes and render your hard disk unusable—unless you have UNLOCK to give you access again. Enter the DEBUG commands shown in Figure 1 into a text file. Compile it by typing

```
DEBUG < filename
```

at the DOS prompt to produce the 49-byte LOCK.COM.

UNLOCK.COM begins as LOCK .COM's identical twin. You can create it by typing

```
COPY LOCK.COM UNLOCK.COM
```

Now start DEBUG, but *don't* load UNLOCK.COM into it yet. Instead type:

```
A 0100
MOV AX,0201
MOV BX,0200
MOV CX,01
MOV DX,80
INT 13
RET
```

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LOCK.SCR
Complete Listing

```
A 0100
MOV AX,0201                    ;Read the partition
MOV BX,0200                    ;table from the hard
MOV CX,0001                    ;disk
MOV DX,0080
INT 13
MOV BYTE PTR [03C2],00         ;Zero out the system
MOV BYTE PTR [03D2],00         ;indicator bytes
MOV BYTE PTR [03E2],00
MOV BYTE PTR [03F2],00
MOV AX,0301                    ;Write the revised
MOV BX,0200                    ;partition table back
MOV CX,0001                    ;to the hard disk
MOV DX,0080
INT 13
RET                            ;Return to DOS

N LOCK.COM
RCX
31
W
Q
```

Figure 1: **Redirect this text file into DEBUG to produce LOCK.COM, but create UNLOCK.COM and copy it to a bootable floppy disk *before* executing LOCK.COM.**

```
G=0100 010E
D03C2 L1
D03D2 L1
D03E2 L1
D03F2 L1
```

In response to each of the last four commands, DEBUG will display an 8-digit address in segment:offset format, followed by a single hexadecimal number. A typical response looks like this:

```
1683:03C0        06
```

Write down the hexadecimal value output by each command (for example, the 06 in the line above). Call the first one *ww*, the second *xx*, the third *yy*, and the fourth *zz*. These are the system indicator values currently recorded in your hard disk's master partition table.

Type Q to quit DEBUG. Start it again, this time loading UNLOCK.COM by typing DEBUG UNLOCK.COM. At the prompt, enter

```
E0112 ww
E0117 xx
E011C yy
E0121 zz
W
Q
```

replacing *ww*, *xx*, *yy*, and *zz* with the values you wrote down earlier. When finished, you will have patched UNLOCK.COM so that it restores the original system indicator values.

Copy UNLOCK.COM to the bootable floppy disk you made and type LOCK to lock your hard disk. After you reboot, DOS will no longer recognize the hard drive. To prove it, reboot from drive A:, then type DIR C:. DOS should answer with "Invalid drive specification." Booting without the floppy disk won't work either, because DOS can no longer read its own system files from drive C:. To unlock the hard disk, type UNLOCK and reboot again. The hard disk should be as good as new.

Use LOCK anytime you know you're going away for a while and want to make sure no one else can use your hard disk. Hide the floppy disk containing UNLOCK in a safe place where snoopers won't be likely to find it.

If something goes wrong and you're unable to unlock the hard disk, you're fine if you backed up the partition table with DOS 5.0's MIRROR command. Simply boot from the floppy disk, type UNFORMAT /PARTN, follow UNFORMAT's directions to restore the partition table, and then reboot your system one more time.

If you follow all these guidelines, LOCK and UNLOCK should prove to be two valuable additions to your DOS toolbox. □

Batch Files Get Even Better With STRINGS 2.0

BY DOUGLAS BOLING

Everyone writes batch files, but no one likes to. The limitations of the DOS batch file command language seem to block you at every turn. That was the reason for STRINGS, the batch file command enhancer presented in our September 10, 1991, issue. Reader response was so positive and requests for additional command functions so numerous that I decided a radical upgrade of STRINGS was in order.

The new version contains not only the batch file commands of the original utility, but 6 enhanced functions and over 35 new ones as well. In all, as shown in Figure 1, STRINGS now adds about 70 commands to the batch file language. (Some of these commands can be used from the DOS prompt as well.) Where the original STRINGS let you add a series of numbers, read a line from a file, or ask a user a question, STRINGS 2.0 includes additional functions that allow batch files to query the date and time, get the current country and codepage, and even read and write to memory locations.

Perhaps the outstanding new feature of STRINGS 2.0 is that under DOS 3.3 or later, it can act as an extension to the DOS command processor, COMMAND.COM. This required rewriting the program so it could become a TSR. Once memory-resident, since COMMAND.COM no longer has to search, load, and run the program, STRINGS's commands execute with the same speed as do such internal COMMAND.COM functions as COPY, RENAME, and DELETE.

The new program bears the same name, STRINGS.COM, as its predecessor. That allows you to upgrade instantly simply by copying the new program over the old. To avoid confusion, I will refer to the original version of the utility as STRINGS1. If you have never used STRINGS1, reading through the original article will be helpful, but I'll try to explain enough to make that unnecessary.

Both STRINGS.COM and its assembly language source code, STRINGS.ASM, can be downloaded from PC MagNet, as explained in the sidebar "Utilities by Modem." In order to assemble the source, you will need an assembler compatible with Microsoft's MASM 2.0. The commands to create STRINGS.COM are

A host of new and enhanced functions for STRINGS gives this popular utility more versatility than ever.

```
MASM STRINGS;
LINK STRINGS;
EXE2BIN STRINGS STRINGS.COM
```

If you don't have a modem, you can request the executable and source code by sending a postcard with your name, address, and preferred disk size to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016. Alternatively, you can fax your request to 212-503-5799. No phone calls, please.

USING STRINGS At first sight, the complete syntax for STRINGS.COM may seem dauntingly complex:

```
STRINGS [/?][/M][/Q][/Pc][/Bn][/I]
  [/U] [env var =] FUNCTION [Params]
```

But it's a lot easier to use than it looks. One reason is that, in addition to this article, the on-screen help facilities are extensive. Simply enter STRINGS at the DOS prompt and you'll get an explanation of every item in the syntax line above. Entering STRINGS /? will give you a complete list of all the commands denoted by *FUNCTION* and

```
STRINGS /? FUNCTION
```

will spell out the purpose, usage, and *Params* (parameters) of each individual command. Note that in both of these last two commands the /? can be replaced by /HELP.

Many STRINGS commands require no arguments; for these you just enter

```
STRINGS FUNCTION
```

For example, to return the last available drive letter, you simply enter

```
STRINGS LASTDRIVE
```

STRINGS will respond by displaying the last available drive letter on your system.

For commands that do take input parameters, the arguments are separated by commas. For example, the command LEFT, which returns the first *n* characters (including spaces) of a string, has two parameters: the input string and the number of characters to return. Thus,

```
STRINGS LEFT This is a string, 9
```

will return the left nine characters "This is a". Note the comma separating the two parameters in the command line.

The results of any STRINGS command can be assigned to an environment variable. Simply insert the name for the variable and an equal sign between STRINGS and *FUNCTION*. For example, by changing the previous example to

```
STRINGS ANSWER =
 LEFT This is a string, 9
```

STRINGS will assign the string "This is a" to the environment variable ANSWER.

As shown above, STRINGS has seven command line switches: /M, /P*c*, /Q, /B*n*, /I, /U, and /?. The switch must be included on the command line before the environment variable or, if no variable is specified, before the command.

By default, STRINGS stores variables in the Active environment, which is created by the current copy of COMMAND.COM. If the /M switch is used, however, STRINGS stores variables in the master environment, which is created by COMMAND.COM when DOS starts.

In Windows, while each DOS box has its own Active environment, all share the Master environment. By using the /M switch, variables can be read by all programs, including those in individual Windows DOS boxes. The /M switch is also useful when you want to preserve a variable assignment you make while shelled out from a program, for the local environment is lost when you exit from DOS back into your application.

Reverting to the previous example, to assign the results to the environment variable RESULT in the Master environment, the command would be

```
STRINGS /M RESULT =
 LEFT This is a string, 9
```

The MASTERVAR command returns the string assigned to a variable in the Master environment. For example, the command

```
STRINGS MASTERVAR RESULT
```

returns the string assigned to the RESULT environment variable even if this command is executed in a different DOS box from the one that was used in previous examples!

The /P*c* (or Parse) switch tells STRINGS to use the *c* character rather than the comma to separate multiple parameters. This switch allows you to work with strings that contain commas.

The /Q (or Quiet) switch, which was added in a maintenance release of STRINGS 1.0, prevents STRINGS from

STRINGS COMMANDS

1 of 2

	Function and Syntax	Returns
New	2FCHECK *n* or *Alias*	The status of programs hooked to the Multiplex Interrupt.
Enhanced	ADD *n1*, *n2*[, *n3*] [, *n4*] [, *n5*] [, *n6*] [, *n7*] [, *n8*] [, *n9*] [, *n10*]	The sum of the parameters.
New	ADDCOMMAS *n* *	*n* parsed with commas every three digits.
New	AND *n1*, *n2*[, *n3*] [, *n4*] [, *n5*] [, *n6*] [, *n7*] [, *n8*] [, *n9*] [*n10*]	The logical AND of the parameters.
Enhanced	ASK [*Prompt string*] [, *Max chars*] [, 1=No echo]	A response from a user.
New	BIOSDATE	The date for the ROM BIOS.
Enhanced	CHAR *c*[*c*] [*c*] [*c*] [*c*] [*c*] [*c*] [*c*] [*c*]	ASCII number of character.
New	CODEPAGE	The active codepage. Requires DOS 3.3 or later.
New	CONVERT *n*, *New Base*	A number with the specified base.
New	COUNTRY	The country code for the system.
New	DATE	The current date in mm-dd-yyyy format.
New	DAY [*Index* (1=Sunday, 2=Mon]	The name of the day of the week.
	DIV *n*, *n*	The quotient of two numbers.
New	EMSFREE	The amount of free expanded memory.
New	EMSTOTAL	The amount of expanded memory.
New	EMSVER	The version of the expanded memory driver.
	ENVFREE	Bytes free in the environment.
	ENVSIZE	The size of the environment.
New	FILEDATE *Filename*	The date of a file.
	FILEDIR *Filename*	The directory of a filename.
	FILEDRIVE *Filename*	The drive of a filename.
	FILEEXT *Filename*	The file extension.
	FILENAME *Filename*	The filename.
New	FILES	The total number of files that can be open.
	FILESIZE *Filename*	The size of a file.
New	FILETIME *Filename*	The time of a file.
	FIND *String*, *Findstring*	The position of Findstring in String.
	FINDC *String*, *Findstring*	The position of Findstring in String. Case-sensitive.
New	GETKEY	The scan code and ASCII value of next key pressed.
New	HELP [*Strings Command*]	The help text for the specified STRINGS command.
New	IN *Port number*	A byte from an I/O port.
New	INSTALLED	A nonzero number if Strings installed as a TSR.
New	INTERRUPT *Int n*, AX, BX, CX, DX, DI, SI, BP, DS, ES	The registers from an interrupt. *Dangerous!*
	INWIN	1 if Windows is running.
New	LASTDRIVE	The letter of the last possible drive.
	LEFT *String*, *n*	The left *n* characters.
	LENGTH *String*	The string length.
	LINESIZE *Filename*	The number of lines.
	LOWER *String*	The string in all lowercase.
	MASTERENV	The address of the master environment
	MASTERVAR *Variable Name*	A variable from the Master environment.
New	MEMFREE	The largest block of free conventional memory.
New	MEMTOTAL	The amount of conventional memory.

Figure 1: **All commands shown above begin with STRINGS [*dest var* =]. In the listing, *n* designates a number, *c* a character, and *b* a byte.**

STRINGS COMMANDS

2 of 2

	Function and Syntax	Returns
	MID *String, Start c, Length*	The middle *n* characters.
New	MONTH [*Index* (1=January)]	The name of the month.
Enhanced	MUL *n1, n2*[,*n3*][,*n4*][,*n5*] [,*n6*][,*n7*][,*n8*][,*n9*][,*n10*]	The product of the parameters.
New	NOT *n*	The logical NOT of *n*.
New	OR *n1, n2*[,*n3*][,*n4*][,*n5*] [,*n6*][,*n7*][,*n8*][,*n9*][,*n10*]	The logical OR of the parameters.
New	OUT *Port n, Output byte*	Writes a byte to an I/O port.
New	PARSE *String, Token n, Token separator char*	The *n*th token from a string.
New	PEEK *Segment, Offset* [, *n bytes* [, *Word flag*]]	A series of bytes from memory.
New	POKE *Segment, Offset, b1*[,*b2*][,*b3*][,*b4*] [,*b5*][,*b6*][,*b7*][,*b8*]	Writes up to 8 bytes to memory.
	READ *Filename, line number*	A line from a file.
New	REPEAT n of chars, c	A string of *n* characters *c*.
	RIGHT *String, n*	The right *n* characters.
New	SCAN *Segment, Starting Offset, b1* [,*b2*]	The offset of a series of bytes in memory.
Enhanced	SUB *n1, n2*[,*n3*][,*n4*][,*n5*] [,*n6*][,*n7*][,*n8*][,*n9*][,*n10*]	The difference of two numbers.
New	TIME	The current time.
	TRUENAME *Filename*	The complete filename.
New	TRUEVER	The true DOS version. Requires DOS 5.0 or later.
New	UMBLARGE	The largest block of free upper memory.
	UPPER *String*	The string in all uppercase.
Enhanced	VAL *n1, n2*[,*n3*][,*n4*][,*n5*] [,*n6*][,*n7*][,*n8*][,*n9*][,*n10*]	ASCII characters for a number.
	VER	The DOS version number.
	WRITE *Filename, String*	Appends a string to the end of a file.
New	XMSFREE	The amount of free extended memory.
New	XMSTOTAL9	The amount of extended memory.
New	XMSVER	The version of the extended memory driver.
New	XOR *n, n*	The exclusive OR of two numbers.

writing to the screen. This switch is useful if the STRINGS command may produce an error message that you don't want displayed on the screen.

New in STRINGS 2.0 is the /B*n* switch, which is used to change the number base that STRINGS uses to interpret numbers. STRINGS defaults to base 10 arithmetic, but by using the /B switch, you can set the base to any number from 2 to 16. Thus, while the statement

```
STRINGS ADD 9, 1
```

returns the standard value 10, the statement

```
STRINGS /B16 ADD 9, 1
```

returns the "number" A, since A in hexadecimal (base 16) is 10 in decimal. You'll want to use the /B switch working with several of the new STRINGS commands, where it is more appropriate to use hexadecimal than decimal numbers.

If your system is running DOS 3.3 or later, using the /I switch installs STRINGS as a resident extension of COMMAND.COM. (How STRINGS actually accomplishes this will be discussed later.) Unlike most TSRs, which are installed at startup, STRINGS works best if it is installed only when and for as long as needed; it should be removed from memory once the batch file has completed in order to avoid wasting valuable system memory. To uninstall STRINGS, you simply use the /U switch.

Installing STRINGS as a resident extension does not alter the syntax of any of its commands. The speed advantage is dramatic. The disadvantage, however, is that once installed, STRINGS (like all internal COMMAND.COM commands) cannot return an exit code to COMMAND.COM. This means that while STRINGS is resident, you can't use the handy IF ERRORLEVEL statement in .BAT files to test the result of STRINGS commands.

If your batch file requires the error level codes returned by STRINGS, two solutions are available. The first and most obvious is simply not to install STRINGS at the start of the batch file. When not installed, STRINGS 2.0 returns the same error codes as STRINGS 1.0.

The second solution is to specify explicitly the full path to the STRINGS.COM file. When a complete path is specified the resident copy of STRINGS will ignore the command, thus allowing COMMAND.COM to launch a second copy of STRINGS as a transient program. For example, since I keep STRINGS in my UTIL directory, I can force COMMAND.COM to launch a second copy of STRINGS with the command

```
C:\UTIL\STRINGS sub 12, 15
```

The use of the

```
/?
```

and

```
/? FUNCTION
```

switches to obtain on-line help was discussed earlier. It should be noted that on-line help is not available when STRINGS is installed in memory, since the help text would take up an additional 4,500 bytes of memory. To get help for a specific command while STRINGS is installed, simply specify the full path to force execution of a nonresident copy of STRINGS.

STRINGS COMMANDS Providing a detailed explanation of the 70 functions shown in Figure 1 is not easy, so I've divided them into 6 groups: old commands enhanced for STRINGS 2.0, string han-

dling, programmer's, date and time, system memory, and STRINGS management commands. The */? FUNCTION* help screen will suffice for the functions in STRINGS1 if you haven't got access to the original article. (A copy of the original article can be downloaded from PC MagNet.)

Six commands from STRINGS1 have been enhanced: CHAR, VAL, ASK, ADD, SUB, and MUL. In STRINGS1, the CHAR command was limited to returning the single ASCII character that corresponded to a decimal number. Now in STRINGS, CHAR can take up to ten parameters, so ten numbers can be converted into ten ASCII characters. For example, the command

```
STRINGS CHAR 65, 66, 67
```

returns the string ABC.

The VAL command has been similarly enhanced. An ASCII string passed to VAL will produce the series of up to ten decimal numbers that correspond to the characters in the string. The numbers will be separated by spaces. For example, the command

```
STRINGS VAL Doug
```

returns the string

```
68 111 117 103
```

When appropriate, this format can easily be converted into a series of hex bytes by using the /B16 switch. Note that because the capital and small letters have different ASCII values, VAL is inherently case-sensitive.

The enhanced ASK function prints a string and waits for the user to enter a response. Its full syntax is

```
STRINGS [dest var =]
 ASK [Prompt string][,Max chars]
[,1=* echo 2=No echo]
```

After entering the *Prompt string* as the first parameter, you specify the maximum number of characters the user can use to respond as the second. The maximum can be any number between 1 and 127. Although STRINGS works with strings up to 127 characters long, remember that DOS programs can only accept a command line with a *total* length of 127 characters. Thus, setting an environment variable to a long length may cause DOS to overflow the command line of a program that uses that variable.

The third and final ASK parameter is a flag that tells STRINGS not to echo what the user types to the screen. This allows a .BAT file to prompt for a password without its becoming visible on the screen. When the third parameter is a 1, STRINGS echoes asterisks to the screen in place of the characters being typed. If the parameter is 2, STRINGS does not echo any characters to the screen. If neither flag is specified, the user response is echoed.

Three of the math functions—ADD, SUB, and MUL—have been revised to allow you to add or multiply up to ten different numbers in one STRINGS command. For the SUB command, up to nine numbers can be subtracted from the first number in the series. Thus, the command

```
STRINGS SUB 10, 2, 1
```

returns the value 7, which is computed as 10 - 2 - 1.

STRING HANDLING COMMANDS This first set of the new STRINGS commands goes to the root of program's functionality: its ability to manipulate strings.

The PARSE command separates a string into different sections and returns one of those sections. This command makes it easy to separate the different directory strings from the PATH environment variable, for example. The full syntax for PARSE is

```
STRINGS [dest var =] PARSE
 String, section number,
 Separator char
```

The three PARSE parameters are the *string*, the *section number* to return, and the *separator character* to be used to differentiate among sections. The small batch file CHECKEX.BAT, listed in Figure 2, uses the PARSE command to search the PATH and determine the execution order of the program name you provide. This is exactly what COMMAND.COM does when it is asked to launch a program. On my machine, the command

```
CHECKEX brief
```

returned the list

```
C:\UTIL\B.BAT
C:\EDITORS\BRIEF\B.EXE
```

PC Magazine Utilities Updates

As with all good software, the programs presented in *PC Magazine* are upgraded and improved. Here's a partial list of the programs on PC MagNet that have been updated. To download these files from the Utilities/Tips Forum, type GO ZNT:TIPS, type LIB or select Libraries from the menu, then select Library 2 PCMAG UTILS. Type DOW and the filename listed below (for example, DOW ANSI.COM), or select Download a File from the menu.

ADDIT.COM, Version 1.1
ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.5
BCOPY, Version 1.2
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.7
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 3.1
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
PCACCESS.EXE, Version 1.1
RN.COM, Version 3.0
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
ZCOPY.COM, Version 1.4

For a complete list of the programs that are available on PC MagNet, download PCMCAT.ZIP from Library 0 (New Uploads) of the Utilities/Tips Forum.

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CHECKEX.BAT

Complete Listing

```
rem-----------------------------------------------
rem CHECKEX.BAT - Scans the path for a program name.
rem-----------------------------------------------
@echo off
SET index=1
if exist %1.com echo %1.com
if exist %1.exe echo %1.exe
if exist %1.bat echo %1.bat
:loop
   STRINGS pdir = PARSE %path%, %index%,;
   IF . == .%pdir% GOTO exit
   if exist %pdir%\%1.com echo %pdir%\%1.com
   if exist %pdir%\%1.exe echo %pdir%\%1.exe
   if exist %pdir%\%1.bat echo %pdir%\%1.bat
   STRINGS index = ADD %index%, 1
GOTO loop
:exit
SET index=
SET pdir=
```

Figure 2: **CHECKEX.BAT shows the execution priority order for a program name that might be present on a path in .COM, .EXE, and .BAT forms.**

This return discloses a problem: If DOS searches the full path, B.BAT will execute, but B.EXE never will. It seems I should rename that batch file!

As shown by the STRINGS line in CHECKEX.BAT, the PARSE command here uses the PATH environment variable as the starting string. It uses the INDEX environment variable to run through the different directories in sequence. And it uses the semicolon to tell where one directory ends and the next one begins on the PATH statement.

ADDCOMMAS is a simple command that inserts commas every three digits in a number you supply as its argument. If you enter

```
STRINGS ADDCOMMAS 12345678
```

STRINGS will return

```
12,345,678
```

The REPEAT command simply creates a string that consists of the same character repeated *n* times. For example, the command

```
STRINGS REPEAT 25, A
```

will return a string with 25 As. The maximum value for *n* is 127.

The FILEDATE command returns the date on a file. It takes *filename* as its only argument, and the date is returned in a mm-dd-yyyy format. The FILETIME command similarly returns the time when a file was last written, in an hh:mm:ss am/pm format.

TRUEVER returns the true DOS version number, regardless of what is reported by the normal VER command. With the introduction of the SETVER device driver in DOS 5.0, you can trick programs into believing that they are running under a different version of DOS than they actually are. There are times, however, when you need to know the real DOS version: hence, TRUEVER. The number returned is the major version number times 100, plus the minor version number. For example, in DOS 5.0 the number returned is 500.

Although the SETVER device driver is only available on DOS 5.0 (and later), the TRUEVER command will still work under DOS Versions 2.0 though 4.0; it simply returns the same value as does the STRINGS VER command.

The FILES command returns the maximum number of files that can be open on the system at one time. This number is usually, but not always, the number shown in the FILES= statement in your CONFIG.SYS file. Programs such as Windows or Jeff Prosise's UMBFILES can change the maximum number of files, however, so FILES is a handy way to confirm that a program will have enough file handles to run.

The LASTDRIVE command returns the last drive letter that can be assigned to a disk. This is usually set with the LASTDRIVE= line in the CONFIG.SYS file, but again, some programs can modify that value. LASTDRIVE is useful when a batch file must perform an action on all possible drives in the system.

The CODEPAGE command allows batch files to determine the currently active codepage. The codepage number determines the character set your system uses. Most U.S. systems use codepage 437, which is the standard character set. Codepage 850, on the other hand, replaces some of the graphics characters in the 437 codepage with characters used in European languages. To query the active codepage, simply enter STRINGS CODEPAGE.

The COUNTRY command returns the country information for the system. Since DOS 2.0, parameters such as the currency symbol, thousands separator, and the date format can be configured for different countries. The table in Figure 3 shows what the COUNTRY command returns for different values of the first parameter, assuming you live in the U.S.

Entering STRINGS BIOSDATE returns a string, normally containing the date, from address F000:FFF5h in the BIOS ROM. The command assumes the date will be in the first 8 bytes following the address, as it is in most PC compatibles. The command takes no arguments.

The GETKEY command waits for the user to press a key, then returns the ASCII value and its scan code. While the ASK command is limited to returning ASCII characters, GETKEY is also able to return non-ASCII keys such as the cursor keys and the function keys. The codes are returned with the ASCII code first, followed by a space, followed by the scan code. It is at this point that you can use the PARSE command to operate separately on the ASCII and scan codes

COUNTRY CODES

First Parameter Value	Returns	Comments
No parameter	Country Code	Active country code
0	Date Format	0 = mm-dd-yyyy
1	Currency Symbol	$ for the US
2	Thousands Separator	, for the US
3	Decimal Separator	. for the US
4	Date Separator	- for the US
5	Time Separator	: for the US
6	Currency Format	0 for the US
7	Currency Places	2 for the US
8	Time Format	0 = 12-hour format
9	Data Separator	, for the US

Figure 3: **These are the different values returned when 1 is supplied as the parameter for the COUNTRY command.**

returned by the keystroke.

The next four commands—AND, OR, XOR, and NOT—extend the math commands to logical operations. The AND command returns the logical AND of the parameters you supply. Likewise, the OR and XOR commands return the logical OR and exclusive OR of their respective parameters. Like the ADD, SUB, and MUL commands, the AND and OR commands can take up to ten parameters. XOR, of course, takes only two. The NOT command returns the one's complement of its single parameter.

The CONVERT command, which converts a number to a different base, became necessary once the /B switch was introduced. This command takes two parameters: the number to be converted and the new number base. As with all commands, both the number and new base parameters are interpreted in the base specified in the /B switch. For example, to convert the hexadecimal (base 16) number 2FB to decimal, the command would be

```
STRINGS /B16 CONVERT 2FB, A
```

Note here that the second parameter, A, is not the character A, but rather the number 10, in hexadecimal. Going the other way, the command

```
STRINGS CONVERT 763, 16
```

returns the hexadecimal number 2FB. (Because the default base for STRINGS is base 10, the /B switch is not required in this case.)

TIME AND DATE COMMANDS The next four commands return times and dates. The DAY function returns the current day of the week: STRINGS DAY will return Tuesday if today is Tuesday. As an added feature, if the DAY command is passed a number between 1 and 7, it returns the day corresponding to that number. STRINGS DAY 6 returns the string Friday, for example.

The MONTH command is entirely similar to the DAY command and again, if passed a number between 1 and 12, it returns the month corresponding to that number.

The DATE command returns the current date in a mm-dd-yyyy format. The TIME command similarly returns the current time in a hh:mm:ss am/pm format. Users requiring a different format for the time and date can easily use the multitude of STRINGS commands to present the data in any form they wish.

SYSTEM MEMORY The enhanced STRINGS contains a number of commands that deal with system memory. MEMTOTAL returns the total conventional (DOS) memory available to the system, and MEMFREE returns the amount of conventional memory still available for use. Note, however, that the MEMFREE command will respond differently when STRINGS is installed as resident. COMMAND.COM does not release its memory when resident commands are executed, so if STRINGS is resident when this call is made, the amount of free conventional memory indicated will be small or nonexistent.

The XMSTOTAL command returns the total amount of extended memory in the system, and XMSFREE returns the amount of free extended memory. Normally, extended memory is managed by an extended memory (XMS) manager, such as HIMEM.SYS. If no XMS manager is present, STRINGS uses a BIOS Int 15h call to determine the amount of extended memory. In this case, as there is no memory manager present to differentiate between free and used extended memory, both the XMSFREE and XMSTOTAL calls will return the same number. XMSVER returns the version of the XMS memory manager in use; if none is present, the command returns 0.

Expanded memory is correspondingly queried with the EMSTOTAL, EMSFREE, and EMSVER commands. Again, if no expanded memory manager is installed, EMSVER will return 0.

The final memory command is UMBLARGE. This command returns the size of the largest free upper memory block (UMB). UMBs are blocks of memory that reside between the video memory at A000h and the BIOS ROM at E000h or F000h. This command is useful for determining whether there is room in upper memory for TSRs.

PROGRAMMER'S COMMANDS The next series of commands are designed for the PC programmer. They allow batch files to actually perform functions previously reserved for .COM and .EXE files.

PEEK, the first of these commands, allows a batch file to read a series of bytes from memory. The syntax of the PEEK command is

```
STRINGS [dest var=] PEEK Segment,
 Offset [,Number of bytes]
 [,Word flag]
```

The first two command parameters are the segment and offset of the memory address to be read. The optional third parameter is the number of bytes to be read; if this parameter is absent, STRINGS returns 1 byte. The fourth and final parameter is also optional. If it is 2, STRINGS will return the bytes read from memory in a 2-byte, or word, format.

To illustrate, in order to see which shift keys are pressed, you can use the PEEK command to read the keyboard status bytes at 40:17 and 40:18 hex. The command would be

```
STRINGS /b16 PEEK 40, 17, 2
```

The complementary POKE command writes data directly to memory. Again, the first parameter is the segment and the second is the offset of the address. The remaining parameters, up to an additional eight, are the bytes to write to memory. Note that while these bytes are being written, interrupts are disabled so the system doesn't read partially written data. The following short batch file uses the PEEK, AND, and POKE commands to turn off the keyboard NumLock.

```
STRINGS /b16 shift = PEEK 40, 17
STRINGS /b16 shift = AND %SHIFT%, DF
STRINGS /b16 POKE 40, 17, %SHIFT%
SET shift=
```

You could also use the POKE command to overwrite the DOS command interrupt vector (Interrupt 21) with zeros; the command would be

```
STRINGS /B16 POKE 0, 84, 0, 0, 0, 0
```

Don't try this example, however, for it will surely lock up your machine!

As this last example illustrates, POKE—and other programming commands that will be discussed shortly—can easily be misused and thereby cause harm. So make sure you fully understand

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CIRCLE 075 ON READER SERVICE CARD

a command before you use it.

The IN and OUT commands give batch files the ability to read and write to system I/O (Input/Output) ports. It is through these ports that the system talks to disk drive controllers and to devices connected to serial and/or parallel ports. The IN command takes only one parameter, namely, the address of the I/O port. This address is the first of the OUT command's two parameters, the second being the data byte to write to that port.

An amusing example that demonstrates the use of the IN and OUT commands is provided by the batch files NOIZE and MARY, which are listed in Figure 4. NOIZE.BAT plays a note on the PC speaker by toggling the speaker control bits in the keyboard control I/O port (I/O address 61h). The proper timing for the note is determined by using PC hardware timer 3. MARY.BAT calls NOIZE.BAT to play the familiar "Mary Had a Little Lamb." My thanks to Neil Rubenking for this entertaining example.

The INTERRUPT command is easily the most powerful—and therefore dangerous—command in the STRINGS repertoire. The command calls an interrupt and returns the values of the registers. The ten parameters for this command specify the interrupt number and the values of most of the processor registers at the time the interrupt is called. Its syntax is the following:

```
STRINGS INTERRUPT Int Number, AX,
 BX, CX, DX, DI, SI, BP, DS, ES
```

The string returned is a series of numbers, separated by spaces, that represent the value in each of the registers at the time the interrupt returns. The format for the returned string is

```
AX BX CX DX DI SI BP DS ES Flags
```

The Flags register contains such flags as Carry, Zero, Sign, and Interrupt Enable. Just as a value is returned for each of the other registers, a value is also returned for the Flags register. It is the responsibility of the batch program to examine the value returned for the Flags register to determine the state of any flags that might be important. For this purpose, the AND and OR commands often prove useful.

NOIZE.BAT and MARY.BAT

Complete Listing

```
@ECHO OFF
REM ------------------------------------------------------------
REM NOIZE.BAT - by Neil Rubenking
REM
REM Enter a frequency as its command line parameter and it
REM starts a note of that frequency.  Enter NO parameter and it
REM shuts the speaker up.
REM ------------------------------------------------------------
IF '%1'=='' GOTO Stop
STRINGS inv=DIV 1193180,%1
STRINGS inv=CONVERT %inv%,16
STRINGS inv=RIGHT 0000%inv%,4
STRINGS Hi=LEFT %inv%,2
STRINGS Lo=RIGHT %inv%,2
STRINGS /b16 OUT 43,B6
STRINGS /b16 OUT 42,%lo%
STRINGS /b16 OUT 42,%hi%
STRINGS /b16 AL=IN 61
STRINGS /b16 AL=OR %AL%,3
STRINGS /b16 OUT 61,%AL%
GOTO End
:Stop
STRINGS /b16 AL=IN 61
STRINGS /b16 AL=AND %AL%,FC
STRINGS /b16 OUT 61,%AL%
:End
SET al=
SET inv=
SET hi=
SET lo=
```

```
@ECHO OFF
REM ------------------------------------------------------------
REM MARY.BAT - by Neil Rubenking
REM
REM Plays a familar tune
REM ------------------------------------------------------------
STRINGS /I /Q
CALL NOIZE 330
CALL NOIZE 294
CALL NOIZE 262
CALL NOIZE 294
CALL NOIZE 330
CALL NOIZE 330
CALL NOIZE 330
CALL NOIZE 330
CALL NOIZE 294
CALL NOIZE 294
CALL NOIZE 294
CALL NOIZE 294
CALL NOIZE 330
CALL NOIZE 392
CALL NOIZE 392
CALL NOIZE 392
CALL NOIZE
STRINGS /U /Q
```

Figure 4: **NOIZE.BAT and MARY.BAT combine to play "Mary Had a Little Lamb."**

An example of this complex command in action will be helpful. Suppose you want to know the address of the InDOS flag. The newly documented function for getting the InDOS address is Interrupt 21, AH = 34. The STRINGS command to enter would be

```
STRINGS /B16 INTERRUPT 21,
 3400, 0, 0, 0, 0, 0, 0, 0, 0
```

The /B16 switch is used to tell STRINGS to "talk" in hexadecimal, which is handy because most PC programming is done in base 16. The 21 indicates that you want STRINGS to call Interrupt 21h, the DOS command dispatcher. The 3400 indicates that AX is to be loaded with 3400h when the interrupt is called. In fact, you only need to load AH (with 34h), but the command has no way of loading the individual byte halves of the registers. Thus, you end up loading AX with 3400, which puts 34 in AH and 00 in AL. The remaining registers for this interrupt are not important, and actually

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QUICK REFERENCE CARD

STRINGS Command

Douglas Boling — December 22, 1992 (Utilities)

Purpose: Greatly expands the number and scope of function commands added to the DOS batch file language by the original STRINGS utility (*PC Magazine*, September 10, 1991). Provides functions for string manipulation, prompting and processing user input, handling variables either in the local or master environment, performing arithmetic on multiple parameters in multiple number bases, performing logical and programming operations, returning error-level codes, reporting on system information and memory (conventional, expanded, and extended), and determining file and system date/time information. Can be made a memory-resident extension of COMMAND.COM under DOS 3.3 and later.

Format:

```
STRINGS [/?][/M][/Q][/Pc][/Bn][/I] [/U]
[env var =] FUNCTION [Params]
```

Remarks: Entering STRINGS at the DOS prompt brings up a help screen explaining the syntax components above. A listing of all STRINGS *FUNCTION* commands can be obtained by entering STRINGS /?, and STRINGS /? *FUNCTION* gives the syntax and *Parameters* for each command. (/HELP may be used in place of /?.) User-supplied parameters must be separated by commas unless the /P*c* switch is used to assign another character as the delimiter. By default, *en*vironment *var*iables are stored in the current environment; the /M switch puts them in the Master environment, from which they can be accessed directly from any Windows DOS box. Assigning a null string to a variable erases that variable from the environment.

Using the /Q switch prevents information from being echoed to the screen. The /B*n* switch changes the default decimal number base to any value of *n* from 2 to 16. Note that numbers returned by one command for use by another require the same /B*n* setting on both lines.

The /I switch installs STRINGS as a resident extension of COMMAND.COM under DOS 3.3 and later. This speeds *FUNCTION* execution, but it requires considerable DOS memory and it prevents use of the IF ERRORLEVEL statement in .BAT files. Install only when necessary and then uninstall with the /U switch.

The original article and the new STRINGS.COM and .ASM files (requires Microsoft Macro Assembler 2.0 or compatible) can be downloaded from PC MagNet.

they don't have to be included at all. STRINGS loads 0 in the registers not specified.

On my machine running MS-DOS 5.0, the command above returns the string

```
3400 321 0 0 0 0 0 0 116 7246
```

The INTERRUPT command always returns a string with ten numbers, each separated by a space. Because the /B16 switch was used, all the values are in hexadecimal. The first number, 3400, is the value of the AX register when the interrupt returns. The important values, however, are 321, the value of BX on the return; and 116, which is the returned value of ES. The *MS-DOS Programmer's Reference* indicates that the address of the InDOS flag will be returned in ES:BX.

You can now use the PEEK command to check the state of the InDOS flag. That command would look like this:

```
STRINGS /B16 PEEK 116 321
```

Although knowing the address of the InDOS flag has little use for batch file programming, other interrupts can come in quite handy. The undocumented interrupt 21 AX=5200 returns a pointer to DOS's list of lists. This pointer is quite useful for checking out the current state of the machine. Shortly I'll present a batch file that uses the list of lists to determine the current memory usage for the system.

The final programmer's command is SCAN. This command searches memory for a series of bytes. The segment to search and the starting offset are specified in the first two parameters. The remaining parameters (up to an additional eight) are the bytes to use in the search. For example, to search the segment 23h for the byte series 10 20 30 40 the command would be

```
STRINGS /
B16 SCAN 23, 0, 10, 20, 30, 40
```

Since SCAN searches only the segment specified, additional SCAN commands are needed for any searches beyond the original segment.

When used in conjunction with the improved VAL command, SCAN can search for an ASCII string in memory. An example is shown in the following batch code fragment, which searches the DOS kernel for the string "NUL":

```
STRINGS /B16 VALSTR = VAL NUL
STRINGS /B16 /P SCAN 116
 0 %VALSTR%
```

As previously discussed, the VAL command returns the ASCII numbers for each of the characters in the first parameter. In this case, because the /B16 switch is used, VAL returns the numbers 4E 55 4C as a series of hex bytes. These bytes are assigned to the VALSTR environment variable. The new InDOS command mentioned above starts at offset 0 and uses the VALSTR environment variable for its remaining arguments. On my machine, this fragment returns the address 116 52, which is the address for the NUL device driver name. That address is important because the NUL device driver is the first in the DOS device driver chain.

Two additional notes about this batch fragment are in order. First, the lack of commas separating the parameters in the SCAN command is not a typo. The /P switch is used here to change the parse character to a space. This is convenient, since the VAL command returns its numbers separated by spaces.

The second important detail concerns the consistent use of the /B switch. While it may not seem that the /B switch would be needed for either command, if it is used in the VAL command it must be used in the SCAN command. Since VAL uses a /B16 switch, it returns its numbers in hex. Because the result from the VAL command is used in the SCAN command, SCAN must use the same base. Why was the /B16 switch used in the first place? Remember that the DOS segment returned by the INTERRUPT command was returned in hexadecimal, which forced the use of the /B switch since we used that number. Just follow this simple rule: If parameters are shared across STRINGS commands, they should use the same base, or you should use the CONVERT command to change the parameters to the proper base.

STRINGS MANAGEMENT The final group of new STRINGS commands are to manage STRINGS itself. STRINGSVER returns the version of STRINGS currently being used. Since this command did not exist in the first version of STRINGS, calling it with STRINGS1 will result in an error message and a return code of 1. If STRINGSVER returns a nonzero ERRORLEVEL code, then STRINGS 1.*x* is running. For the present version of STRINGS, the STRINGSVER command returns the ASCII string 200 and a return code of 0.

The INSTALLED command returns a 1 if STRINGS is currently installed as a TSR extension to COMMAND.COM. If STRINGS is not installed, a 0 is returned. This command is useful for those situations in which a STRINGS command might produce different results if the utility were installed. MEMFREE represents one such case, and the use of return codes may be another.

INSIDE STRINGS For the most part, the enhanced version of STRINGS simply involved adding procedures for the new functions. The main change to the program itself was the rewriting of the command parsing routine to use less memory. This was necessary so that STRINGS could be turned into a TSR. Of greatest programming interest, however, is the hook into COMMAND.COM's internal command dispatcher.

In *Undocumented DOS*, coauthor Jim Kyle has an informative chapter on command interpreters. It describes an undocumented "back door" into COMMAND.COM that allows TSRs to hook into the internal command dispatcher. This back door was first included in DOS 3.3 so that DOS's APPEND command could check on any subsequent APPEND commands. Fortunately for programmers, that door has remained open in all later DOS releases.

When you enter a command at the DOS command line, COMMAND.COM must determine whether the command is an internal function to be executed or an external program that must be launched. Before making its decision, COMMAND.COM calls the Multiplex Interrupt (Int 2Fh) with AX equal to AE00h. At the time of the call, DX is loaded with FFFFh, BX is pointing to a buffer that contains an exact replica of the command line just typed, and SI points to a buffer that contains the potential command in uppercase preceded by a length byte.

TSRs such as STRINGS that hook

BATMEM.BAT

Complete Listing

```
@echo off
rem ------------------------------------------------------------
rem
rem A batch file that returns a memory scan
rem BATMEM.BAT
rem Copyright 1992 Douglas Boling
rem
rem ------------------------------------------------------------
rem
rem First, get the pointer to the list of lists
rem
strings /i /b16 iret = interrupt 21, 52
strings /b16 lloff = parse %iret%, 2
strings /b16 llseg = parse %iret%, 9
set iret=

rem
rem First memory block kept at ListOfList - 2
rem
strings /b16 lloff = sub %lloff%, 2
strings /b16 memseg = peek %llseg%, %lloff%, 2, 2

echo.
echo  Block Owner Size Program
echo  ------------------------------

strings /b16 totalmem = add %memseg%, 1
set freemem=0
:loop
   rem
   rem Parse the memory arena header
   rem
   strings /b16 memtype = peek %memseg%, 0, 1
   strings /b16 memowner = peek %memseg%, 1, 2, 2
   strings /b16 memsize = peek %memseg%, 3, 2, 2

   strings /b16 memtemp = peek %memseg%, 8, 8
   strings /b16 /p  memtemp = char %memtemp%

   strings /b16 memseg = add %memseg%, 1
   rem
   rem If block not PSP, don't print block name
   rem
   set memname=
   set diff=-1

   strings /b16 /q diff = sub %memseg%, %memowner%
   if .%diff% == .0 goto skip1
   goto skip2
   :skip1
      set memname=%memtemp%
   :skip2

   if NOT %memowner% == 0000 goto skip3
      set memowner=FREE
      strings /b16 freemem = add %freemem%, %memsize%
   :skip3
   rem
   rem OK, print the results
   rem
   echo  %memseg% %memowner% %memsize% %memname%

   strings /b16 memseg = add %memseg%, %memsize%
   strings /b16 totalmem = add %memsize%, %totalmem%
   strings /b16 totalmem = add %totalmem%, 1

if %memtype% == 4D goto loop

echo.

strings /b16 memsize = mul %memsize%, 10
strings /b16 memsize = convert %memsize%, A
strings memsize = addcommas %memsize%

strings /b16 totalmem = mul %totalmem%, 10
strings /b16 totalmem = convert %totalmem%, A
strings /u totalmem = addcommas %totalmem%

echo  %totalmem% bytes total conventional memory
echo  %memsize% largest program executable size
echo.
rem
rem Done, clean up all vars
rem
set llseg=
set lloff=
set memseg=
set memowner=
set memsize=
set memtype=
set memname=
set memtemp=
set freemem=
set totalmem=
set diff=
```

Figure 5: **This batch file produces a list of the DOS memory segments.**

into this call must compare the command to which SI points with the command they wish to handle. For STRINGS, that means checking to see whether SI is pointing to the ASCII string "STRINGS".

A TSR that wants to claim the command puts 0FFh in AL, copies the command line pointed to by BX into an internal buffer, and returns to COMMAND .COM. Otherwise the TSR must pass the Multiplex request down the interrupt chain with all registers unmodified.

If a TSR claims the command, COMMAND.COM calls the Multiplex Interrupt again, this time with AX loaded with AE01h. Having claimed it, the TSR must now execute the command. While most of the registers during this call are the same as in the AE00h call, Kyle recommends that a TSR should copy the buffer from the earlier AE00h call because not all the registers are explicitly loaded before the AE01h call. Once the command has been completed, the TSR should zero the size byte in the buffer to which SI points. This tells COMMAND.COM that the command has been processed.

While STRINGS doesn't provide every possible function a batch file might want, the inclusion of such commands as PEEK, POKE, and INTERRUPT allow the programmer to create just about any command. An example of this power is shown in BATMEM.BAT, which is listed in Figure 5.

BATMEM scans the DOS memory blocks and displays the blocks that are being used as well as the ones that are free. BATMEM is similar to the MEM command that has been included in DOS since Version 4.0. Among the STRINGS functions BATMEM uses are INTERRUPT, PARSE, CHAR, PEEK, and ADDCOMMAS.

Notice that in BATMEM, STRINGS is installed with /I at the beginning of the batch file and removed with /U at the end. These two switches double the execution speed. If you don't want STRINGS installed and removed, simply delete the /I and /U switches; the remainder of the batch file will be unaffected.

Programs like BATMEM give but a taste of the world STRINGS opens to enterprising batch file writers. To supplement STRINGS commands, you may also wish to acquire Michael J. Mefford's excellent BATCHMAN utility in the January 30, 1990, issue of *PC Magazine.* Like STRINGS, BATCHMAN is available on PC MagNet.

The ability to perform low-level actions, coupled with the convenient features of STRINGS's high-level commands, provides a wealth of new opportunities for the once-lowly batch file. Try STRINGS, and your batch files will never be the same. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO *PC MAGAZINE.*

Exploring the FONTMETRICS Structure, Part 1

BY CHARLES PETZOLD

I'd like those of you who have a PostScript printer to perform a little experiment: Type the PostScript code shown in Figure 1 into a text file and copy the file to your printer. You may have to wait a few minutes before the page ejects.

This little program selects a 504-point Times Roman font and displays all the characters in the PostScript character set overlapped on top of each other. The result, of course, is an irregular mass of black on the page.

The point size of a font is commonly defined as the distance from the lowest part of any character to the highest part of the character. There are 72 points to the inch, so you probably expect that the composite character image you've just printed will be exactly 7 inches high. Go ahead and measure it. You'll find the height to be only 6¾ inches.

Curious? If your printer supports the 35 standard PostScript fonts, try changing Times Roman to Palatino Roman. This time you'll find the image is about 7⅛ inches high—larger than the point size would indicate. Now try the Symbol font. The composite character image is over 9 inches high.

What on earth is going on? It's actually quite simple: The point size of a font is not a metrical concept, it's a typographical design concept. Point size originated back in the days of metal type, when each letter was printed from a block of metal. The point size was the size of the metal type, not the height of the letterform on the type. The height of the letterform was usually a little smaller so that successive lines of text did not touch.

In these days of computer typography, the actual height of the letterforms can be larger or smaller than the point size. This is a decision left up to the font designer. All that can be said is that the point size of a font approximates the distance from the lowest part to the highest part of the characters of the Roman alphabet (A through Z and a through z without accent marks).

In this column we will begin exploring the all-important FONTMETRICS structure that describes fonts supported under the OS/2 2.0 Presentation Manager. Some of the structure fields we'll examine indicate the font point size, and others provide more precise font metrics. One warning, though: If you attempt to reconcile the point size to the other font metrics, you'll slowly go insane.

Examining the FONTMETRICS structure—which describes fonts supported under OS/2 2.0—begins with a look at the fields relating to the sizing of characters.

THE FONTMETRICS STRUCTURE The FONTMETRICS structure is defined in OS2DEF.H, as shown in Figure 2. The structure is divided into several groups of fields, which I've indicated by inserting blank lines.

As I demonstrated in the last issue, you use the FONTMETRICS structure with the GpiQueryFonts function to obtain the characteristics of all the fonts available for a video display or printer. In a future column we'll see that you also use the FONTMETRICS structure with the GpiQueryFontMetrics function to obtain the characteristics of the font currently selected into a presentation space. The font metrics information allows you to work intelligently with the font, for instance, to space successive lines of text.

I presented a program last time called FONTLIST that displayed the fields of the FONTMETRICS structure for all the fonts available on the video display or your default printer. If you have this program up and running under the OS/2 Presentation Manager, you may want to examine the values of actual FONTMETRICS fields as I discuss them.

The first two fields (szFamilyname and szFacename) provide the family name and face name of the font as zero-terminated character strings. The FACESIZE constant is defined as 32, so the names are limited to 31 characters. I discussed the OS/2 font family and face names in the November 24, 1992, column.

For a bitmap font, the family name and face name are the same, as System Proportional or Tms Rmn. For outline fonts supported by the Adobe Type Manager, the family name will be something like Helvetica and the face name perhaps Helvetica Bold Italic.

Some face names (like New Century Schoolbook Bold Italic) may exceed 31 characters. There is a provision for obtaining longer names that I'll discuss in the next issue, but be forewarned that it doesn't seem to work yet.

The idRegistry field is usually zero, but for some bitmap fonts included with OS/2 2.0, it indicates an IBM registered number for the font. This field has little value for the programmer.

The usCodePage field is also usually set to zero (or is otherwise not very meaningful) when you obtain FONTMETRICS information using GpiQueryFonts. This is because most fonts support multiple code pages. Code pages indicate how

TIMES.PS

Complete Listing

```
/Times-
Roman findfont 504 scalefont setfont
/st ( ) def
32 1 255 {
          st 0
          3 -1 roll
          put
          72 216 moveto
          st show
          } for
showpage
```

Figure 1: **A PostScript program that overlaps all the characters of a 504-point Times Roman font.**

the 256 character codes map to particular glyphs; I'll have more to say about them in a future column. Note for now that fonts containing symbol or dingbat characters (such as the OS/2 Symbol Set font) have a usCodePage field of 65400. This indicates an unregistered code page.

FONT DIMENSIONS Now we come to the core of the FONTMETRICS structure—the 12 fields that describe the size of the characters in the font. These sizes are reported in world coordinates. As you'll recall, I wrote the FONTLIST program so that the values are shown both in pixels and decipoints (tenths of a point). For the decipoint values, I set world coordinates based on the font resolution (which is not the real resolution of the video display) reported by DevQueryCaps. For the VGA, this font resolution is 96 dpi.

The lEmHeight and lEmInc fields provide the point size of the font in vertical and horizontal world coordinates, respectively. For example, the System Proportional font is 10 points. For a VGA with a horizontal and vertical resolution of 96 dpi, a point is equivalent to 1⅓ pixels. Thus, a 10-point font is 13 pixels high (rounded to the nearest pixel), as indicated by the lEmHeight and lEmInc fields for this font. In decipoints the point size should be 100, but you'll note that FONTLIST reports it as 98. This is obviously a rounding error.

The use of the letters Em in the lEm Height and lEmInc fields is based on classical typography. This terminology originated when type was only uppercase. The capital M was a square, the height and width of which was equal to the point size. Now the em is considered to be a square, its height and width equal to the point size. Thus for a 12-point font, an em-square (also called an em-quad) is 12 points wide and 12 points high.

The lEmInc field does not indicate anything about the width of the characters in the font. It's simply the point size of the font in horizontal world coordinates. Suppose you're running the Presentation Manager on an EGA display. The font resolution of the EGA is 96 dpi horizontally and 72 dpi vertically. A 10-point font will show an lEmHeight value of 10 pixels (one pixel per point vertically) and an lEmInc value of 13 pixels.

When you enumerate bitmap fonts using GpiQueryFonts, don't determine the point size of each font using the lEmHeight and lEmInc fields. Instead use the sNominalPointSize field, which I'll describe in the next issue.

When you examine outline fonts reported by GpiQueryFonts, the lEmHeight and lEmInc fields—as well as the other ten metrics in this group—are meaningful only in a relative sense. Sometimes the fields are based on a 10-point font and sometimes on a 12-point font. As I'll discuss in a future column, after you select an outline font in a presentation space, you set the font's point size in integral and fractional world coordinates using GpiSetCharBox.

GpiSetCharBox lets you set the font height and width independently. Thus you can make adjustments if world coordinates represent unequal dimensions horizontally and vertically. Or you can make a font more compressed or expanded than it normally is.

After you use GpiSetCharBox to size an outline font selected in the presentation space, you can then call GpiQueryFontMetrics to determine the font metrics. You'll find that the lEmHeight and lEmInc fields of the FONTMETRICS structure are the same as the values passed to GpiSetCharBox, rounded to the nearest integer. The other ten fields in this group are scaled accordingly.

If you believe (as I do) that the only rational way to specify font size is in points, this is probably comforting news.

For the next five fields of the FONT METRICS structure following lEmHeight, you'll want to take a look at Figure 3. The screen shot shows a 100-point Times New Roman font with five characters from code page 850: a 50 percent "gray" block (code point 0xB1, a hold-

The FONTMETRICS Structure

```
typedef struct _FONTMETRICS
    {
    CHAR     szFamilyname [FACESIZE] ;
    CHAR     szFacename [FACESIZE] ;

    USHORT   idRegistry ;
    USHORT   usCodePage ;
             .
    LONG     lEmHeight ;
    LONG     lXHeight ;
    LONG     lMaxAscender ;
    LONG     lMaxDescender ;
     LONG     lLowerCaseAscent ;
    LONG     lLowerCaseDescent ;
    LONG     lInternalLeading ;
    LONG     lExternalLeading ;
     LONG     lAveCharWidth ;
    LONG     lMaxCharInc ;
    LONG     lEmInc ;
    LONG     lMaxBaselineExt ;

    SHORT    sCharSlope ;
    SHORT    sInlineDir ;
    SHORT    sCharRot ;

    USHORT   usWeightClass ;
    USHORT   usWidthClass ;

    SHORT    sXDeviceRes ;
    SHORT    sYDeviceRes ;

    SHORT    sFirstChar ;
    SHORT    sLastChar ;
    SHORT    sDefaultChar ;
    SHORT    sBreakChar ;

    SHORT    sNominalPointSize ;
    SHORT    sMinimumPointSize ;
    SHORT    sMaximumPointSize ;

    USHORT   fsType ;
    USHORT   fsDefn ;
    USHORT   fsSelection ;
    USHORT   fsCapabilities ;

    LONG     lSubscriptXSize ;
    LONG     lSubscriptYSize ;
    LONG     lSubscriptXOffset ;
    LONG     lSubscriptYOffset ;
    LONG     lSuperscriptXSize ;
    LONG     lSuperscriptYSize ;
    LONG     lSuperscriptXOffset ;
    LONG     lSuperscriptYOffset ;
    LONG     lUnderscoreSize ;
    LONG     lUnderscorePosition ;
    LONG     lStrikeoutSize ;
    LONG     lStrikeoutPosition ;

    SHORT    sKerningPairs ;
    SHORT    sFamilyClass ;

    LONG     lMatch ;

    LONG     FamilyNameAtom ;
    LONG     FaceNameAtom ;

    PANOSE   panose ;
    }
FONTMETRICS ;
```

Figure 2: **The FONTMETRICS structure as defined in OS2DEF.H. It's used with the GpiQueryFonts function to obtain the characteristics of all the fonts available for a video display or printer.**

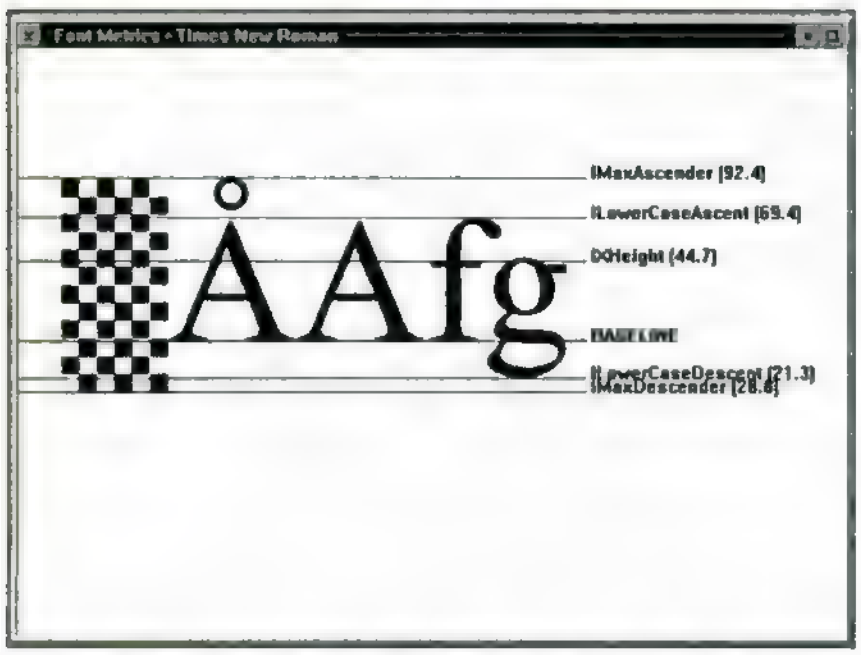

Figure 3: **Font metrics illustrated using a 100-point Times New Roman outline font.**

over from the original IBM character set), a capital A with a ring accent (code point 0x8F), a Roman capital A, and the lowercase letters f and g. The lines illustrate the levels of the five fields of the structure along with their numeric values in points (actually decipoints displayed with a decimal).

All values are measured from the baseline in positive numbers. The lXHeight field is the height of lowercase letters without ascenders. The *x height* is a concept in classical typography, so called because it is the height of a lowercase x. If the top of a lowercase letter is rounded (as with a g), then the actual height of the letter may be a little greater than the lXHeight value would indicate. Fonts are usually designed like this to preserve optical regularity.

The lLowerCaseAscent and lLowerCaseDescent fields describe the topmost and bottommost extents of lowercase letters. (lLowerCaseDescent is a positive number indicating a distance below the baseline.) You'll notice that the uppercase A does not quite reach the lLowerCaseAscent field. One common font metric that is missing from the FONTMETRICS structure is the "caps height." Sometimes this is the same as the lowercase ascender, and it could be a little larger, but in many fonts the caps height is smaller than the lowercase ascender.

The lMaxAscender and lMaxDescender fields indicate the maximum vertical extents of all the characters in the font. In particular, the block characters and the line-drawing characters from the original IBM PC character set span the entire distance from lMaxDescender and lMaxAscender. But most other characters don't come close. One exception is the Times New Roman A with the ring accent, which reaches lMaxAscender.

The lMaxBaselineExt field is simply the sum of lMaxAscender and lMaxDescender:

```
lMaxBaselineExt =
lMaxAscender + lMaxDescender
```

In the case of the 100-point Times New Roman font, lMaxBaselineExt is 92.4 plus 28.8 or 121.2 points. Interestingly enough, a rough rule for spacing successive lines of text is 120 percent of the font point size. The lMaxBaselineExt field is a good value for line spacing, particularly if you'll be displaying accented characters in your text. It guarantees that successive lines of text do not touch, except for the old boxes and line drawing characters, which should touch.

This brings us to the lInternalLeading field. Internal leading is not a typographical concept. It was invented for Windows as a fudge factor to account for the difference between the point size and the maximum height of the characters in the font. The lInternalLeading field is the difference between lMaxBaselineExt and lEmHeight, or 21.2 for the Times New Roman font shown in Figure 3. Thus,

```
lMaxBaselineExt = lEmHeight +
  lInternalLeading
```

The concept of external leading is more typographical, but it also had its origins in Windows. External leading was supposed to be a recommended amount of space that programs would add to the total font height to space lines of text. However, this has been abandoned in OS/2 2.0 (it was subsumed into internal leading), and the lExternalLeading field is set to zero for the OS/2 fonts.

The lAveCharWidth field is a weighted average of the width of lowercase letters in the font. This is a handy value for roughly estimating the width of character strings. The lMaxCharInc field is the maximum width of the characters in the font.

RECONCILING THE POINT SIZE Earlier I warned you about attempting to reconcile the point size with the other font metrics. As you'll note from Figure 3, the sum of lLowerCaseAscent and lLowerCaseDescentl is 90.7, and the sum of lMaxAscender and lMaxDescender (the lMaxBaselineExt field) is 121.2. The point size is 100, between these two numbers.

It's tempting to try to show two additional lines on Figure 3 to display the 100-point range of the point size. But where should they go? We've already exhausted all the metrics information we have.

Is this information important? It could be. If you're displaying text containing only unaccented Roman letters, you might want to space lines of text using the point size rather than lMaxBaseline Ext, which would give tighter line spacing. But how do you position the first line of text? You need to know how much of the point size is above the baseline.

Generally, diagrams that illustrate how to include internal leading show it at the top; that is, measured down from lMaxAscender. Thus, the point size would be measured upward from lMaxDescender. If you turn to IBM's on-line documentation for the Presentation Manager API, you'll find lInternalLeading defined as: "The amount of space which, when subtracted from lMaxAscender, gives a font-design dependent, but glyph-set independent, measure of the distance above the baseline that characters extend."

This seems to indicate that internal leading is at the top and that the point

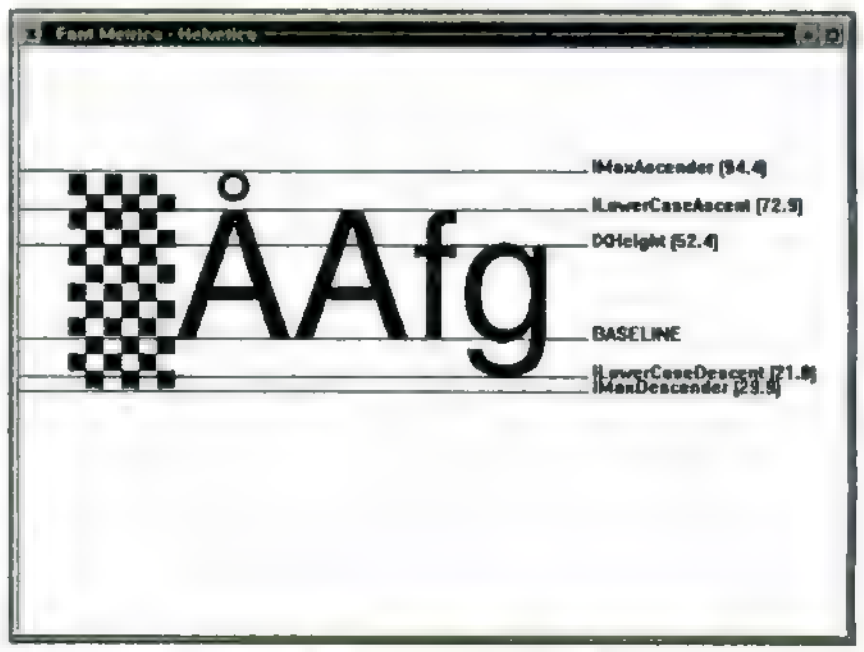

Figure 4: **Font metrics illustrated using a 100-point Helvetica outline font.**

size is measured upwards from lMaxDescender. For the Times New Roman font shown in Figure 3, subtracting lInternalLeading (21.2) from lMaxAscender (92.4) yields 71.2, which is 1.8 points higher than lLowerCaseAscent (69.4). This seems reasonable.

The IBM documentation continues: "This calculation thus approximates the visual top to a row of characters without actually looking at the characters in the row. The recommended use of this field by applications is to position the first line of a block of text by subtracting it [that is, lInternalLeading] from lMaxAscender and positioning the baseline that distance below whatever is above the text."

This is exactly the problem we're trying to solve! Fantastic! There's just one problem: It doesn't work, at least not for some fonts. Let's take a look at a 100-point Helvetica font in Figure 4.

The lMaxBaselineExt value is 124.3 points and lInternalLeading is 24.3 points. Subtract lInternalLeading from lMaxAscender (94.4) and you get 70.1, which is 2.8 points below lLowerCaseAscent (72.9). Thus, if you use IBM's rule, the first line of text will be positioned too high and the tops of the characters will be cut off. This leads me to conclude that the IBM documentation of lInternalLeading is incorrect and inappropriate for line spacing.

APPROACHES TO LINE SPACING As I cautioned at the outset of this column, attempting to reconcile point size to the other font metrics is flirting with madness. But we can stop short of insanity and use what we know to develop some reasonable rules for spacing text.

By default, when displaying text under the OS/2 Presentation Manager, specify a *y*-coordinate that corresponds to the baseline. As a simple general-purpose approach to line spacing, use lMaxBaselineExt to adjust the *y*-coordinate from one baseline to the next. Place the baseline of the first line lMaxAscender units below where the text is to begin. This line spacing allows sufficient space between the top of accented capitals and the bottom of lowercase descenders.

If you use only unaccented letters in the Roman alphabet, you can tighten up line-spacing to the point size. To position the first line of text, assume that the point size extends an equal distance above lLowerCaseAscent and below lLowerCaseDescent. This means that internal leading occupies space at the top and the bottom of the lMaxBaselineExt range (although mostly at the top). So, to position the first line of text, take the sum of lLowerCaseAscent and lLowerCaseDescent (90.7 for the 100-point Times New Roman font and 94.7 for the 100-point Helvetica font), subtract that from the point size, and divide by two, yielding 4.65 and 2.65. Add that value to lLowerCaseAscent.

It's not quite as clean as having lEmAscender and lEmDescender values in the FONTMETRICS structures, but it will have to do. The primary reason why these values don't exist is that they are not part of the Adobe font metrics (.AFM) files.

I'll continue the discussion of the fields of the FONTMETRICS structure in the next issue. □

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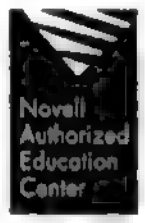

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CIRCLE 230 ON READER SERVICE CARD

Multitasking and Multithreading In Windows NT

BY RAY DUNCAN

Objects, objects, objects! Microsoft's NT (New Technology) operating system uses objects everywhere to manage system resources, and these objects exhibit all the classic attributes: They encapsulate resource state and ownership information, the handles for objects are polymorphic, and processes can inherit object handles from their parents. In short, NT is object-oriented from top to bottom (though the need for symmetry with Windows 3.x sometimes makes this less than obvious at the WIN32 API level) and one of the main jobs of the NT microkernel is to create, destroy, and synchronize access to objects. We'll see some interesting examples of this object orientation as we look at the WIN32 functions for process and thread management.

First, though, we need to introduce some terms that will be new to Windows programmers although familiar to OS/2 programmers. An executable file on-disk is a program; 32-bit programs in Windows NT use a new executable file format called the PE format (for paged executable or portable executable) that is a superset of the UNIX Common Object File Format (COFF). When a program is loaded into memory and prepared for execution, it becomes a process; a process owns an address space, file handles, and other system resources, and multiple copies of a program (called instances) can be running at the same time. The Windows NT scheduler, however, knows nothing about processes; it distributes the CPU cycles among entities called threads. A thread consists of an instruction pointer, a state (executing, ready to execute, or blocked), a priority, general register contents, and a stack. Every process has one thread of execution when it starts, but it can create more threads at will in order to carry out multiple tasks in a desynchronized fashion.

WIN32 PROCESS MANAGEMENT The WIN32 API includes three functions for starting a new process: WinExec(), LoadModule(), and CreateProcess(). WinExec() and LoadModule() exist mainly for backwards compatibility with the WIN16 API; they are actually implemented in terms of CreateProcess() and they have the same syntax and semantics as their WIN16 counterparts, so we won't discuss them here. CreateProcess(), on the other hand, is unique to WIN32 and reveals the full functionality of the NT executive for WIN32 applications.

From top to bottom, NT is object-oriented. A look at the WIN32 process and thread management functions reveals several intriguing examples.

The CreateProcess() function is very powerful and appears complex, but it's actually straightforward to use. The parameters to CreateProcess() are:

- The address of an executable image filename; this pointer can be NULL if the next parameter is supplied.
- The address of an ASCIIZ command line; if the pointer to the executable image filename is NULL, WIN32 uses the first blank-delimited token of the command line as the executable filename, appending the .EXE extension if necessary.
- The address of a security attributes structure for the new process; this parameter can be NULL.
- The address of a security attributes structure for the first thread of the new process; this parameter can be NULL.
- An inheritance flag to be specified as TRUE if the new process is to inherit any inheritable handles from the parent or FALSE if it is to inherit nothing.
- Process creation flags controlling the new process's priority class, debugging status, detached status, and whether or not the process will be given a window and/or a new logical console.
- The address of an environment block; this pointer can be NULL, in which case the new process will inherit an exact copy of the parent's environment.
- The address of an ASCIIZ string specifying the current directory for the new process; this parameter can be NULL, in which case the new process will use the current directory of the parent.
- The address of a STARTUPINFO data structure that contains, among other things, the title, size, and position for the new process's window.
- The address of a PROCESS_INFORMATION structure that receives information about the new process if the CreateProcess() call is successful.

Once the new process is launched, the parent can retrieve the process ID, first thread ID, process object handle, and first thread object handle for the new process from the PROCESS_INFORMATION structure. The process and thread IDs are nearly useless to the immediate parent process, but the process and thread object handles can be used with other WIN32 APIs to get information about the child process or control its behavior. For example, the parent process can use the process object handle with the WaitForSingleObject() and GetExitCodeProcess() functions to wait until the child process terminates and then obtain its exit code respectively. Alternatively, it can use the process object handle with the SetPriorityClass() function to al-

ter the child process's priority, or with the TerminateProcess() function to unilaterally kill the child process.

Inheritance of handles by the child process is entirely under the control of the parent. When it opens files and allocates other system resources, the parent always has the option to make the file or resource noninheritable by setting up a security attributes structure appropriately. Assuming, however, that the handles correspond to inheritable resources and that the inheritance flag parameter for CreateProcess() is TRUE, the child process can inherit any and all of these:

- Process object handles for other processes started by the parent or inherited by the parent from its parent;
- Event object handles (more about these in a later installment);
- Semaphore object handles;
- Mutual exclusion object handles;
- File handles; and
- Console input and output handles.

A process normally exits by calling the WIN32 function ExitProcess(), although this call is usually implicit for C-language programs. (ExitProcess is called automatically by the C runtime library after the main() or WinMain() function exits.) Any file handles and resources the process owns at the time of termination are closed and cleaned up automatically. A normal exit by a process has no direct effect on the execution of its children, but if a process is killed by some other process's call to TerminateApp(), its nondetached children will be killed as well.

WIN32 THREAD MANAGEMENT Threads, which are sometimes known as lightweight processes, have been around in some form for a long time, but they first came to the attention of microcomputer programmers in OS/2. Threads provide a very elegant and powerful mechanism for decomposing a process's work into several asynchronous subtasks. Building an application with multiple threads is superior to designing it as a suite of processes because the system overhead of creating or destroying a thread is very low (much smaller than creating or destroying a process). And interthread communication is very fast because all of the threads in a process are running in the same address space and can communicate through common memory.

Unfortunately, threads never really lived up to their promise in any OS/2 software I encountered, in part because the multiprocessor support that was always promised for OS/2 (which would allow the various threads of a process to execute in parallel on separate CPUs) never materialized.

A WIN32 process creates new threads within itself by calling the function CreateThread(). CreateThread, like CreateProcess(), has many parameters:

- The address of a security attributes structure for the new thread; this parameter can be NULL.
- The size of the stack for the new thread; this parameter can be 0, in which case the system will automatically allocate a new stack of the default size.
- The address of the starting point for execution of the new thread.
- An application-specific 32-bit parameter that is passed to the new thread on the stack (this can of course be a pointer to a complex data structure).
- A flag that determines whether the new thread will run immediately or will be created in the suspended state.
- The address of a variable that will receive the thread ID for the new thread.

The threads of a process can control their own execution, and each other's execution, with the WIN32 functions SetThreadPriority(), SetThreadContext(), SuspendThread(), ResumeThread(), EnterCriticalSection(), LeaveCriticalSection(), and Sleep(). One of the most welcome functions is TerminateThread(), which is useful under many circumstances and which inexplicably remained absent from the OS/2 API despite many requests. There are several informational thread functions as well, such as GetThreadPriority, GetThreadContext(), GetCurrentThread(), GetCurrentThreadId(), and GetExitCodeThread().

A thread ends its own execution by calling ExitThread(), passing a status code which can be retrieved by other threads, or by simply returning from the function which was the thread's starting point. One thread can wait for another's termination using the target thread's object handle and WaitForSingleObject() or WaitForMultipleObjects(). The process as a whole terminates when its primary thread exits or when any of its threads calls the ExitProcess() function.

THE NTSHELL2 PROGRAM This issue's program, NTSHELL2, demonstrates how to use a few of the most important multitasking functions. NTSHELL2 is very similar to the NTSHELL program in the November 24, 1992, issue, but I've recast it to use the WIN32 process and thread functions in an explicit manner. The source code for NTSHELL2 is shown in Figure 1. You can download the

NTSHELL2.C

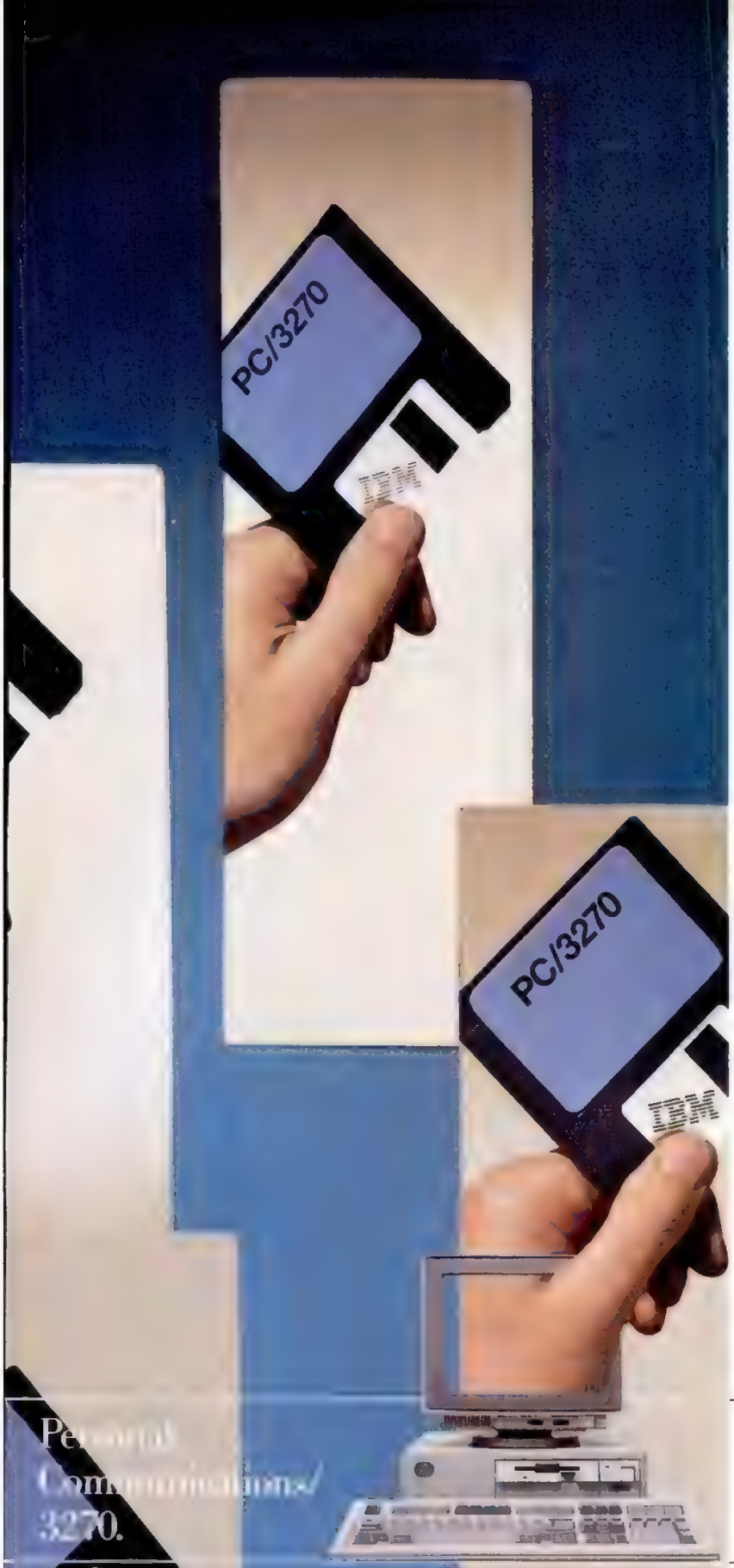
1 of 2

```
// NTSHELL2.C   Simple extendable command interpreter
//              illustrating use of WIN32 process and
//              thread creation API.
//
// Copyright 1992 Ray Duncan
// PC Magazine * Ziff Davis Publishing

#include "windows.h"
#include "stdio.h"
#include "process.h"
#include "stdlib.h"
#include "string.h"
#include "ntshell.h"

//
// This table associates "intrinsic" commands with the
// routines that carry them out.
//
struct decodeCmd commands[] = {
    "CLS",   doCls,
    "DOS",   doDos,
    "EXIT",  doExit,
    "KILL",  doKill, };

char comspec[MAXEXENAMESIZE];                // pathname of CMD.EXE

char msg1[] = "\nCan't run CMD.EXE.\n";      // misc. error messages
char msg2[] = "\nCreateProcess failed.\n";
char msg3[] = "\nNo COMSPEC in environment.\n";
char msg4[] = "\nCreateThread failed.\n";
char msg5[] = "\nTerminateProcess failed.\n";

HANDLE hConIn;                               // console input handle
HANDLE hConOut;                              // console output handle


VOID main(int argc, char *argv[])
{
    char buffer[INPUTSIZE];                  // keyboard input buffer
```

Figure 1: **This is the source code for NTSHELL2, the multitasking/multithreading version of the NTSHELL program that appeared in Issue 20's column.**

NTSHELL2.C


```
    // open handles for console input and output
    hConIn =  CreateFile("CONIN$", GENERIC_READ | GENERIC_WRITE,
                         FILE_SHARE_READ | FILE_SHARE_WRITE,
                         NULL, OPEN_EXISTING, 0, NULL);
    hConOut = CreateFile("CONOUT$", GENERIC_READ | GENERIC_WRITE,
                         FILE_SHARE_READ | FILE_SHARE_WRITE,
                         NULL, OPEN_EXISTING, 0, NULL);

    // bail out if we can't get console I/O handles
    if((hConIn == (HANDLE) -1) || (hConOut == (HANDLE) -1))
        exit(TRUE);

    getComspec(comspec);                    // get pathname for CMD.EXE

    while(TRUE)                             // main interpreter loop
    {
        getCommand(buffer);                 // get command from user
        if(strlen(buffer))                  // ignore empty lines
            if(!intrinsic(buffer))          // if intrinsic, run worker
                extrinsic(buffer);          // else assume external program
    }                                       // & try to create new process
}

//
//  intrinsic() -- try and match user's command with intrinsic
//  command table.  If a match is found, run the associated routine
//  and return TRUE, else return FALSE.
//
UINT intrinsic(char *input)
{
    int i, j;                               // scratch variables
    char token[64];                         // scratch buffer

    while(*input == '\x20') input++ ;       // discard leading blanks

    i = strcspn(input, " ;/,-");            // search for delimiter
    memset(token, 0, sizeof(token));        // zero out token buffer
    strncpy(token, input, i);               // copy first input token
    strupr(token);                          // fold token to upper case

    for(j = 0; j < dim(commands); j++)      // search command table
    {
        if(!strcmp(commands[j].name, token))
        {                                   // if match, run routine,
            (*commands[j].fxn)(&input[i]);  // passing the command tail
            return(TRUE);                   // and return true status
        }
    }
    return(FALSE);                          // no match, return false
}

//
//  extrinsic() -- process an unrecognized command by attempting
//  to create a child process, using the first token of the input
//  as the program name.  If the child process is created, also
//  create a supervisor thread that will wait for the child's
//  termination and then display a message.
//
VOID extrinsic(char *input)
{
    STARTUPINFO startupinfo;                // used by CreateProcess
    PROCESS_INFORMATION processinfo;        // used by CreateProcess
    char temp[256];                         // scratch formatting buffer
    DWORD tid;                              // returned thread ID

    // initialize process startup information structure
    memset(&startupinfo, 0, sizeof(STARTUPINFO));
    startupinfo.cb = sizeof(STARTUPINFO);
    startupinfo.lpTitle = "Child of NTSHELL";

    // now attempt to launch the child process
    if(!CreateProcess(NULL,                 // image filename
                      input,                // command line
                      NULL,                 // process security attributes
                      NULL,                 // thread security attributes
                      TRUE,                 // inherit handles
                      NORMAL_PRIORITY_CLASS |
                      CREATE_NEW_CONSOLE,   // process creation flags
                      NULL,                 // use current environment
                      NULL,                 // use current directory
                      &startupinfo,         // startup information
                      &processinfo))        // receives process info
        putMsg(msg2);                       // error message if failed
    else
    {
        // launch OK, display child's handle and start supervisor thread
        wsprintf(temp, "\nNew process handle: %d\n", processinfo.hProcess);
        putMsg(temp);
        if(!CreateThread(NULL,              // thread security attributes
                         0,                 // stack size = default
                         supervisor,        // starting address
                         processinfo.hProcess,  // argument for thread
                         0,                 // flags: run immediately
                         &tid))             // receives thread ID
            putMsg(msg4);                   // error message if failed
    }
}

//
// supervisor() - this routine is run as a separate thread each time
// a new child process is launched.  It blocks on the child's process
// handle and displays a message when the child terminates.
//
DWORD supervisor(HANDLE hProcess)
{
    char temp[256];

    WaitForSingleObject(hProcess, INFINITE); // wait for child to terminate
    wsprintf(temp, "\n\nProcess %d died.\n", hProcess);
    putMsg(temp);                           // audit child's termination
    return(0);                              // implied ExitThread(0)
}

//
//  getCommand() - issue prompt, get user's command from console,
//  and make it ASCIIZ.
//
VOID getCommand(char *buffer)
{
    DWORD count;

    putMsg("\nntshell: ");                  // display prompt
    ReadFile(hConIn, buffer, INPUTSIZE, &count, NULL);
    buffer[count-2] = 0;                    // clip off CR-LF
    strupr(buffer);                         // fold to upper case
}

//
//  getComspec() -- get the full pathname for CMD.EXE
//  from the "COMSPEC=" variable in the environment.
//
VOID getComspec(char *buffer)
{
    strcpy(buffer, getenv("COMSPEC"));      // get COMSPEC variable
                                            // from environment
    if(!buffer[0])
    {                                       // if no such variable,
        putMsg(msg3);                       // display error message
        exit(1);                            // and exit
    }
}

//
// putMsg() -- display a string on the console.
//
VOID putMsg(char *string)
{
    DWORD count;

    WriteFile(hConOut, string, strlen(string), &count, NULL);
}

//
//  These are the subroutines for NTSHELL's intrinsic commands.
//

VOID doCls(char *input)                     // CLS command =
{                                           // erase the window
    DWORD count;
    COORD coord;
    CONSOLE_SCREEN_BUFFER_INFO si;

    GetConsoleScreenBufferInfo(hConOut, &si); // get screen dimensions

    coord.X = 0;                            // buffer coordinates for
    coord.Y = 0;                            // start of blanking = (0,0)

    // fill screen with blanks, set cursor at upper left corner
    FillConsoleOutputCharacter(hConOut, ' ', si.dwSize.X * si.dwSize.Y,
        coord, &count);
    SetConsoleCursorPosition(hConOut, coord);
}

VOID doDos(char *input)                     // DOS command = start
{                                           // child copy of CMD.EXE
    if(spawnlp(P_WAIT, comspec, comspec, NULL))
        putMsg(msg1);                       // error message if failed
}

VOID doExit(char *input)                    // EXIT command =
{                                           // terminate NTSHELL
    exit(FALSE);                            // with success status
}

VOID doKill(char *input)                    // KILL command = kill
{                                           // child process by handle
    HANDLE hProcess;

    while(*input == '\x20') input++ ;       // discard leading blanks
    hProcess = (HANDLE) atoi(input);        // convert handle number
    if(!TerminateProcess(hProcess, 0))      // terminate child process
        putMsg(msg5);                       // error message if failed
}
```



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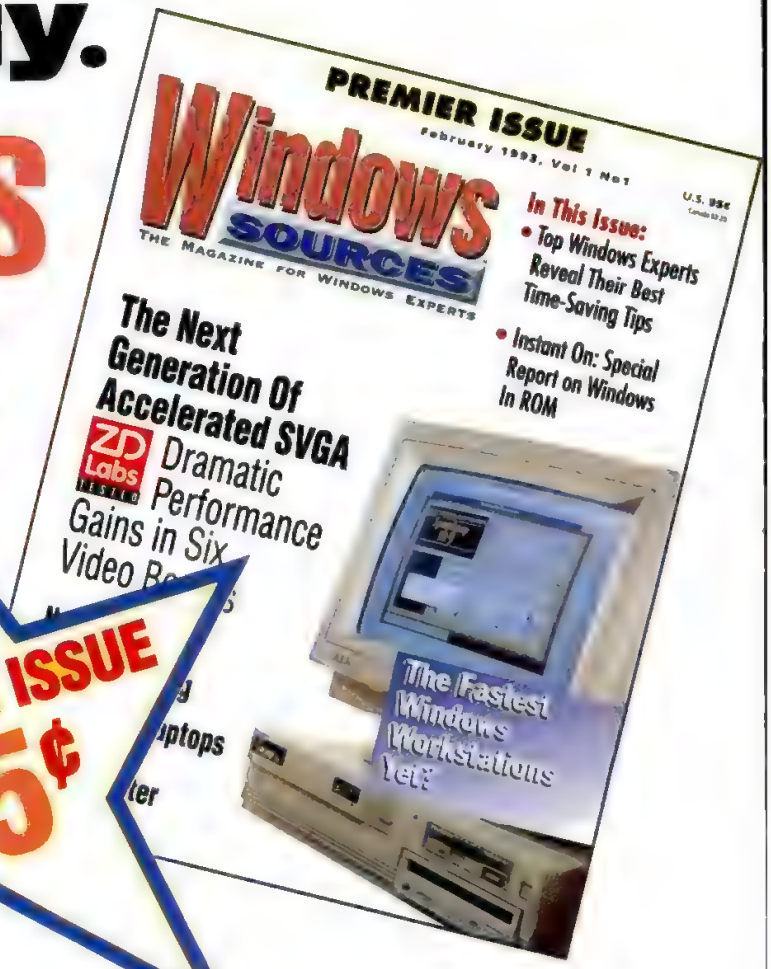

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CIRCLE 309 ON READER SERVICE CARD

source code and executable files from PC MagNet archived as NTS2.ZIP.

Like its predecessor, NTSHELL2 is table driven. The main loop of the program reads a line of input from the user, then calls intrinsic() to see whether the user has entered a command that is intrinsic (built-in) to NTSHELL2. The first token of the user's input is compared against the table commands[], which contains the names of the intrinsic commands CLS, DOS, EXIT, and KILL; and the addresses of the routines which carry out those commands: doCls(), doDos(), doExit(), and doKill(). If a match is found, intrinsic() executes the appropriate routine and returns a TRUE flag, otherwise it returns a FALSE flag. If intrinsic() does not recognize the user's input, the routine extrinsic() is called.

Extrinsic() assumes that the first token of the user's command is the name of an executable file on-disk, and it tries to run that program by passing the entire command line to CreateProcess(). The CREATE_NEW_CONSOLE parameter is used in the CreateProcess() call so that the child process, if it is not a GUI application, will get its own virtual console and so will not block input to NTSHELL2. If the CreateProcess() call is successful, extrinsic() displays the new process's handle and calls CreateThread() to start a new thread that will wait for the child process's termination; otherwise, extrinsic() gives an error.

The thread that monitors a child process's execution has its starting and ending point in the routine supervisor(). Supervisor() is passed the child process's handle on the stack, and it immediately uses this handle in a call to WaitForSingleObject() to block itself until the child terminates. Supervisor() then formats and displays a message that informs the user of the child process's death and subsequently terminates itself. Note that several threads may be active or blocked within the identical machine code in supervisor() at any time. To keep the code simple, I've made no attempt to keep the display within the window pretty or to address issues of reentrance in the routines that are called by supervisor().

You should also examine the doKill() routine in NTSHELL2. This routine is called when the user enters the KILL command, and it expects a process handle number in the command tail. It converts the handle number to binary and calls TerminateProcess() to kill the child application, then displays a message indicating whether TerminateProcess() was successful. (Obviously it will fail if you enter an invalid handle number or if the child process has terminated itself.)

ERRATA In the column of October 27, 1992, I mistakenly used the term hInstance in several places where I meant to use hPrevInstance. I'm not sure whether to blame this on old age or on sleep deprivation. At any rate, the second paragraph under the subhead "Infrastructure Procedures" should have read:

WinMain() calls or does not call InitApp() according to the value of hPrevInstance, one of its parameters. Under Windows 3.*x*, if hPrevInstance is zero, this instance of HEXVIEW is the only one running, and InitApp() must be called to register the application's window classes. If hPrevInstance is nonzero under Windows 3.*x*, another instance is already running, and InitApp() is bypassed. hPrevInstance is always zero in a WIN32 or WIN32s environment, so InitApp() will always be called when HEXVIEW is compiled as a 32-bit application.

The underlying message here is that process isolation in Windows NT is far stricter than it is in Windows 3.*x*. It's possible, and sometimes unavoidable, for applications to share many system objects in Windows 3.*x*, such as GDI pens and brushes, window classes, and DLL data segments. Furthermore, all Windows 3.*x* applications run on the same local descriptor table (LDT), which means that any Windows program can (accidentally or maliciously) bash the memory of any other Windows program. In Windows NT, an application can't access another program's resources without that application explicitly making them available, and this segregation goes so deep as to keep a program from knowing whether it is the only instance of that program running unless it goes to a lot of effort.

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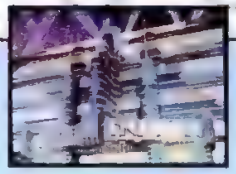

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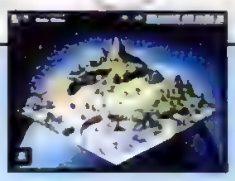

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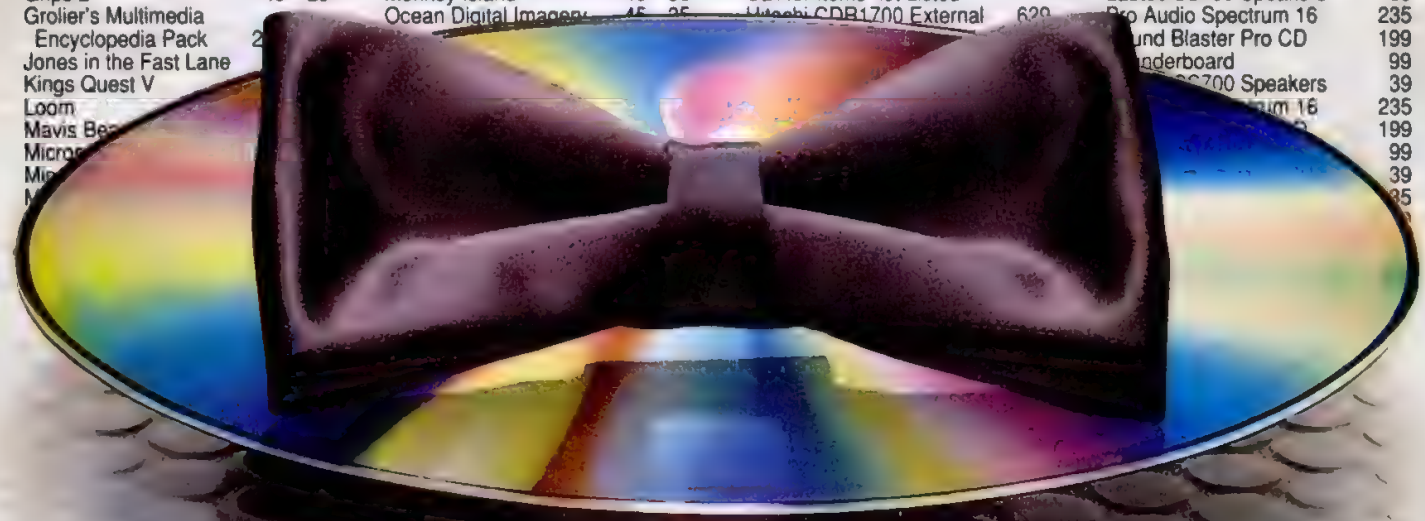

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INDEX

Systems

Acma Computers, Inc. 413
Agatech 444
Ariel Design, Inc. 410
Comtrade 439
Edge Technology 416
EPS Technology 433
Expo Tech 440
FASTMICRO 419
Hyundai Electronics 426
Insight Computers 399
Olympic Computer Technology 443
PCs Compleat 460
PC Innovation 442
Quill Corporation 458
Tandy Direct 429
Tangent Computer, Inc. 457
Tri-Star Computers 414
US Systems & Technologies 430
USA Flex 447
Vortex 462

Software/Peripherals/Components

Arlington Computer Products 480
Buffalo Products 492
Bulldog Computer Products 495
CompUSA 472
Compuclassics 473
Computability 464
Computer Discount Warehouse 476
Computer Express 488
Dustin Discount Software 398,406
FASTMICRO 474
First Source Intl. 494
H. Co Memory Upgrades 493
Hard Drives Intl. 404
Hunter Computers 490
Interlink Electronics 463
LA Trade 487
Landmark 467
Midwest Computer Works 484
Pacific Wave (Paradise) 485
PC Zones 468
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Software Add-Ons 486
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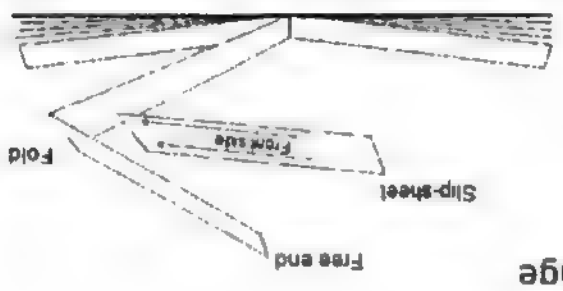

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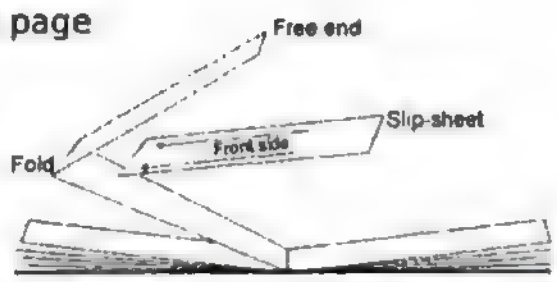

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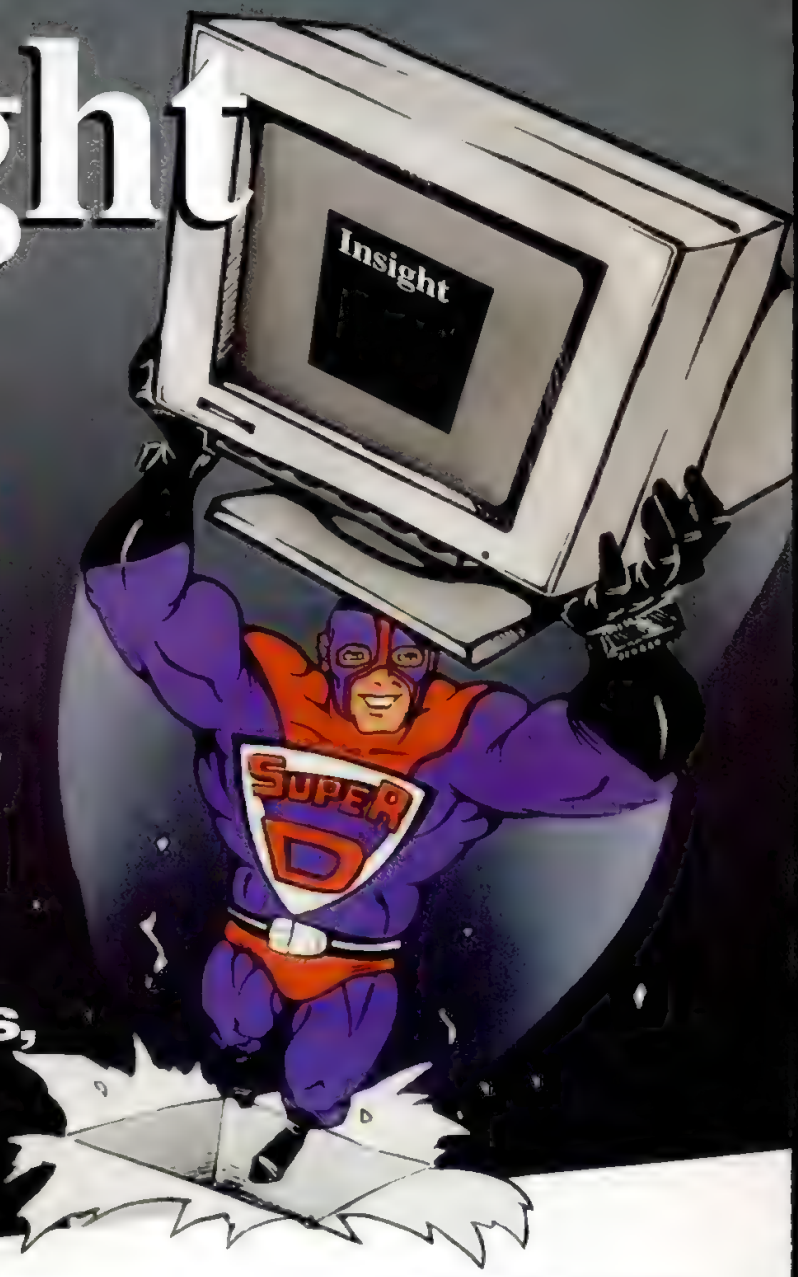

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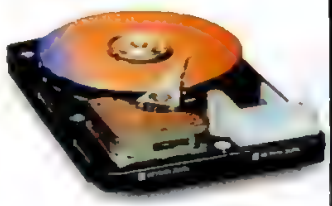

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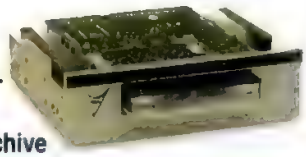

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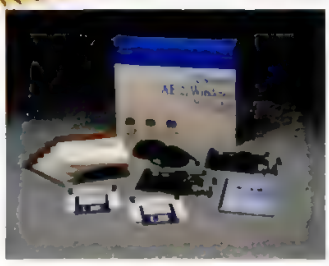

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PCs

ASSIGNING IRQs

❓ I have a fax/voice/modem card, an I/O card, and a scanner card installed on my system. These cards are currently using IRQs 2 through 7. I want to add a CD-ROM drive, but it will have to use IRQs 10 through 15. How can I find out which controllers use these IRQs?

Richard A. Cleaver
via CompuServe

▶**PC MAGAZINE:** Devices such as modems and I/O ports need a way to get the CPU's attention when they are ready to execute a particular action (for instance, when the modem receives an incoming call). One of the most common ways to signal the CPU is through the use of an IRQ (hardware interrupt request channel). However, the task of assigning IRQs when adding new expansion cards to your system can be a nightmare.

In general, you can't assign two devices to the same IRQ. IBM PCs and XTs contained only IRQs 0 through 7. Starting with the IBM AT, systems with 80286 or better processors have IRQs 0 through 15. The additional IRQs were added as part of the 16-bit extension to create what is now the ISA expansion slot. Unfortunately, cards with 8-bit connectors cannot access the signals made available via a 16-bit bus. In addition, interrupts 0 and 1 are reserved for the computer's internal use, so ports and expansion cards have to use IRQ 2 and higher. In a fully configured system, being limited to just 6 IRQs can result in overcrowding.

IRQ Assignments

Device	IRQ
IRQ timer	0
Keyboard	1
IRQ cascade	2
COM1	4
COM2	3
COM3	4
COM4	3
LPT1	7
LPT2	5
Floppy disk controller	6
Real-time clock	8
IRQ cascade from IRQ 2	9
Math coprocessor	13
AT hard disk	14

***Figure 1:* Some IRQ assignments that have become informally standardized.**

Watch out for some 16-bit boards that also are limited to IRQs among the first 8 instead of the full range of 16. Figure 1 shows some IRQ assignments that have become informally standardized.

You'll notice that some devices share the same IRQ assignment. COM1 and COM3 both use IRQ4, for example, while COM2 and COM4 both use IRQ3. This works only as long as the two devices aren't active at the same time. It's unlikely that you'll have two modems active at once (unless you're running two communications programs in a multitasking environment like Windows), so you could have one modem attached to COM1 and another to COM3 without a problem. But it is likely you'll want to use a modem and a mouse together and, if both devices try to become active at the same time, there's a good chance the result will be a system crash.

If you keep track of the IRQs used by the devices in your computer, you'll have an easier job when it's time to configure a new card. Keep a log of all your cards, showing which IRQs they support and which one each card is currently using. If you don't know which IRQs are in use and don't have the documentation for all your cards, you may be able to use a system diagnostic utility such as Manifest (from Quarterdeck Office Systems), or System Sleuth and WinSleuth Professional (from Dariana Inc.).

Keep in mind that if you need to reassign IRQs to avoid conflicts with a new card, you may also need to change your software configuration (such as command line parameters or settings in your Windows .INI files).

Unfortunately, you probably won't find much information about which IRQs a card supports in product literature or in most magazine reviews. Your best approach is to call the tech support line for the company, since they can tell you about any problems you might have configuring the card. And you can get a sense of how good the support will be after you've actually purchased the card, before you lay down your hard-earned cash.
—Alfred Poor

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.
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Peripherals

TRACKING PRINTER USAGE

❓ We have a Hewlett-Packard LaserJet II printer which is shared by a number of people. We need to keep track of how many pages each user prints so we can charge for the amortized cost of the printer and for supplies. Is there any way to do this using either hardware or software?

Larry Burditt
Stillwater, Oklahoma

▶**PC MAGAZINE:** The solution lies in the printer's controller. The LaserJet II controller keeps track of the number of pages

printed and displays it at the top of the self-test printout. You can request this printout simply by taking the printer off-line and holding down the Print Fonts/Test button until SELF TEST shows in the LCD message window. You can also force the printer to perform its self-test and print the page without touching the front panel.

First create a file—let's call it SELFTEST.TXT—that contains just these two characters:

```
<Escape>z
```

That's the Escape character (ASCII 27) and a lowercase z. Since the commands to insert an Escape character vary from editor to editor—and some don't even allow it—let's use EDLIN (the text editor on most DOS machines) to create the file. Assuming EDLIN is on your path, type the following at the DOS prompt:

```
EDLIN SELFTEST.TXT
i<Enter>
Ctrl-V[z<Enter>
Ctrl-C
e<Enter>
```

The self-test command is not widely documented for the LaserJet II, IIP, and LaserJet Plus printers, and not at all for the LaserJet III or IIIP printers, but empirical testing shows that it works for all of them.

Next, create a batch file that contains the following line:

```
COPY SELFTEST.TXT PRN
```

Users can run the batch file at the beginning and end of each printing session. When it's executed, the printer message window will display SELF TEST and, after a short period of time, the self-test page with the page count at the top will appear.

You can use the page count to determine the number of pages printed during a work session simply by subtracting the starting number from the ending one. If you want the charge to include the self-test page, add one, and if not, subtract one.—*Alfred Poor*

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MULTIPURPOSE PERIPHERALS

? I'm about to buy a laser printer for my home office. I could also use a photocopier, a fax, and a full-page scanner at 300 dpi minimum. How many of these functions can I expect to get in a single device?

Kent G. Bridges
Grafton, Wisconsin

▶PC MAGAZINE: While most of us hate the expense of multiple peripherals, we're still waiting for the ideal, all-in-one, plain-paper peripheral to handle our copying, printing, and faxing tasks. For the moment, you're stuck choosing from a range of compromises.

One problem with an all-in-one device is different resolutions—and not just between printing and faxing. While most fax machines conform to the Group 3 CCITT (International Consultative Committee on Telephone and Telegraph) standard, the Group 3 fax specification has two different resolutions for sending (or scanning) and receiving images. Standard mode uses 200 dots per inch for horizontal resolution and only 100 dpi vertical. Fine mode uses 200 dpi in both directions. Receiving fax machines print at 200- by 200-dpi. So if an

INDEX

PCs
Assigning IRQs 408
Peripherals
Tracking printer usage 408
Multipurpose peripherals 409
Operating Environments
Quick start for Program Manager 411
DOS games under OS/2 411
Word Processing
Wrapping text around graphics in WP 412
Sharing dictionary files 414
Spreadsheets
Start with a maximized sheet 418
QPW page-name formula 425
Databases
IsDir for Xbase 428
Graphics
True perspective in CorelDRAW 438
Aligning animation elements 438
Networking
No burst mode in Windows 446
Linking spreadsheets 446
Languages
Variable-argument functions 446
On-Line
ZiffNet/Procomm conflict 466

Powerstrokes:

*Morning practice for the **Head** of the Charles Regatta, Boston*

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intel inside

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incoming fax is in standard mode (just 100-dpi vertical resolution), every line is printed twice. If the incoming fax is in fine mode, the receiving machine prints each line once.

Then there's the difference between fax and printer resolutions. The market settled on 300 dpi as a standard for ink jet and laser printers, though we're now seeing lasers that print at 600 dpi or better. A 600-dpi printer is overkill for incoming faxes, since it can't print a fax at 600 dpi. It can only print at the resolution it receives, which is 200 dpi. If you buy a printer enhancement product, such as Hewlett Packard's LaserJet Fax or JetFax's JetFax II, you can take advantage of the printer's abilities to print at 300 dpi when receiving faxes from other units of the same type.

Using a fax as a scanner may not be acceptable for many applications, especially when you're working with detailed drawings, since faxes scan at only 200 dpi. For high-resolution, full-page scans, you should buy a good desktop scanner. And while many scanners let you print scanned images on your printer, they can't produce copies as fast as a standalone copier. If you need to make more than a few copies, you'll be better off buying a personal copier.

The best choices for faxes are either a fax/data modem that stores incoming faxes on your computer's disk, or a standalone laser fax device that can send incoming faxes directly to your printer. There are even some printers coming on the market with send and receive fax capabilities available as an option. The main advantage of laser fax devices is that most contain an internal memory buffer to store incoming transmissions, so your computer (and in some cases, even your printer) doesn't have to be powered up in order to receive a fax; fax modems need to use at least some of your computer's processing time in order to work. On the other hand, a fax modem stores the image on-disk so you can recall it repeatedly for printing, editing, or resending, while a laser fax device typically gives you just one shot at printing an incoming fax (like a standalone fax machine.) Both types of devices make sending documents easy, however—as easy as printing to a printer through Windows print drivers or DOS TSR utilities.—*Alfred Poor*

Operating Environments

QUICK START FOR PROGRAM MANAGER

TIP Windows 3.1 lets you define shortcut keys for your programs, but I also want to jump directly to the Program Manager. There's no default key sequence to do this, but you can easily set it up yourself. Just create a new program item in your Startup group with PROGMAN.EXE on the command line and assign the key combination you want. Whenever Windows starts, it will automatically assign your shortcut key to Program Manager. An additional benefit is that you can change the title for Program Manager to one of your own choice.

David Jeffrey
Girard, Pennsylvania

▶**PC MAGAZINE:** Application shortcut keys are available only if you're running Windows 3.1 in 386 Enhanced mode. Pressing the shortcut key for an application that's running in the background will bring that application to the foreground immediately. You can also start the application by pressing its shortcut key, but only when Program Manager is the foreground application.

Once a key combination is assigned as a shortcut key, it can't be used for any other purpose under Windows, so it's important to choose your shortcut keys wisely. Valid combinations are Ctrl+Alt+key, Ctrl+Shift+key, Shift+Alt+key, and Ctrl+Shift+Alt+key. Windows won't let you choose an invalid key combination, but it's up to you to avoid using a key that has a special meaning to any of your applications.

To create a shortcut key for Program Manager, first activate Program Manager and open the Startup group. Here's a shortcut *within* Program Manager: To add an item to the Startup group, hold down the Alt key and double-click in any blank area in the group window. This will bring up the Program Item Properties dialog box. Enter PROGMAN.EXE for the command line and anything you like for the title, then tab to the Shortcut key line.

This line is not like the three above it: It accepts only the particular key combinations listed above. Ctrl+Alt is the default, so if you press the P key, you'll see Ctrl+Alt+P on the edit line. Choose a key combination that will be easy to remember and won't conflict with your other applications, then press the OK button to close the dialog box. The new shortcut key will be available the next time you start Windows. Can't wait? Double-click on the Program Manager icon to make the shortcut key available immediately!

Now that you have a shortcut key for Program Manager, you can use it to quickly load other programs that have shortcut keys. Just press the Program Manager shortcut key followed by the shortcut key for another application. The first key activates Program Manager; the second loads your other application.
—*Neil J. Rubenking*

DOS GAMES UNDER OS/2

? Because of Windows' quirkiness, I'm thinking of installing OS/2 2.0 on my new 80486/DX2-50. However, I've amassed a very large library of DOS games and entertainment software that I use very often. Will OS/2's DOS emulation support the software and drivers for the games and game accessories I use? Can I expect the performance to be comparable to what I experience under my DOS/Windows configuration?

Harold Combs
Beattyville, Kentucky

▶**PC MAGAZINE:** First the good news: Under OS/2 2.0 you won't lose the ability to run anything that ever ran on your system under DOS or Windows. When you install OS/2 on a hard disk already formatted with DOS 3.3 or higher, the operating system automatically installs its dual-boot facility, giving you the option of booting into DOS whenever you like. This facility consists of a couple of control files and the BOOT.COM program. When you're in OS/2, run BOOT /DOS, and your system will boot into whatever version of DOS exists on your disk. Running BOOT /OS2 under DOS reverses the process.

But you may never have to return to DOS. OS/2 2.0's DOS emulator is based on MS/PC-DOS 5.0, and the vast major-

ity of DOS games work fine in an OS/2 DOS session. Some may run even better, because an OS/2 DOS session can provide almost 640K free RAM as well as XMS and EMS memory. And OS/2's disk access is a bit faster than DOS's, so games that constantly pull up picture files and overlays may run smoother. You'll want to run the games as full-screen windows, though. Like Windows 3.*x*, OS/2 supports DOS sessions in a window on the desktop. But this slows screen repainting enormously, so you'd probably find the performance unacceptable.

Games that use device drivers do present some problems, especially when the drivers provide a direct interface with hardware devices. There are three ways to load DOS device drivers in OS/2: from CONFIG.SYS, from the settings screen for a DOS session, or as part of a Virtual DOS Machine (VDM). How you load a driver may determine whether or not a game will run.

The first method is the easiest: Just add the device driver line to OS/2's CONFIG.SYS file and reboot. If you don't get an error message, the driver is probably supported and will work when you go into a DOS session.

If you don't need to have the driver loaded in every session, you can assign the game to an icon on the OS/2 desktop and specify the device driver in the DOS settings screen for the game. This way, the device driver will be loaded only when you start the game and will be removed from memory when you exit. Avoid this method, though, if you're planning to multitask various games that use the same device driver; OS/2 will usually find the device already in use by another session and refuse to load the second copy. In this case, load the driver in CONFIG.SYS.

The third approach is more complex, but often works when the first two fail. OS/2 supports what it calls a Virtual DOS Machine whereby you create a boot image of any version of DOS 3.0 or higher that acts as if you booted DOS from a floppy disk.

The first step is to create a DOS boot disk. Boot your system with DOS 3.0 or higher, then format a floppy disk using the /s switch to transfer the system files. Create appropriate CONFIG.SYS and AUTOEXEC.BAT files on the boot disk and, finally, copy the problem drivers to the floppy disk.

If you installed OS/2 on a FAT drive, you'll need to copy the FSFILTER.SYS file from the \OS2\MDOS directory to the floppy disk (you'll have to boot into OS/2 first if your boot drive is formatted with HPFS). Be sure to put the DEVICE=FSFILTER.SYS command as the first line in the floppy disk's CONFIG.SYS file, or you won't be able to access any of the other drives on your system from the VDM.

Once you've created the VDM disk, you can quickly test it to make sure it works. When you install OS/2, it creates an icon group called Command Prompts, one of which is "DOS from Drive A:." Put your boot disk in A: and double-click on this icon. Your customized DOS will boot from the floppy, and you should have full access to the rest of the system. You can then load your game files onto the floppy or run the games from the hard disk to make sure everything works.

If you're satisfied, you can speed things up considerably by creating a DOS boot image on your hard disk. OS/2's VMDISK command will copy the boot disk to an image file with any name you choose. Note that the image file will be the same size as the floppy disk you create it from, so if you're only going to use the image to boot a VDM and then run the program from the hard disk, use a 360K or 720K disk.

After you created the DOS image file, go back to the Command Prompts window and make a copy of the DOS from Drive A: icon; OS/2 will prompt you for a new name for the icon, so you'll want to make it something meaningful. Then open the settings menu and change the DOS_STARTUP_DRIVE setting to point to your image file. From that point on, clicking on the icon boots the VDM almost instantly. You can edit, add, or change the files on the VDM image once you've started it under OS/2, just as if it were a normal floppy disk.

This should also work with older games that don't run under regular DOS and require booting from a floppy disk drive.

Most of the companies that make sound boards and peripherals are working on OS/2 versions of their device drivers, so using DOS drivers under OS/2 should be less of a problem as time goes on.—*Joe Salemi*

Word Processing

WRAPPING TEXT AROUND GRAPHICS

TIP When WordPerfect 5.1 wraps text around a graphic, it treats the graphic as having a straight edge, no matter how irregular the graphic actually is. This often leaves a great deal of unused white space, as shown in Figure 2, which uses the CHKBOX-1.WPG file that ships with WordPerfect. However, it's easy enough to fill in the white space with text and wind up with a more professional look, if you're willing to put in just a little extra work.

The trick is in how you define the graphic. Instead of defining it so text will wrap around it, define it to let text overwrite it. In WordPerfect 5.0 or 5.1, press Alt-F9, choose Figure (or Box type in 5.0), choose Create, then enter the graphic file to use and set Wrap Text Around Box to No. Next define a set of additional graphics that won't print anything on the page but will serve to outline the irregular edge (or edges) of the graphic. By defining each of these to have text wrap around them, you can create as irregular a text border as you need.

Figure 3 shows the same graphic as

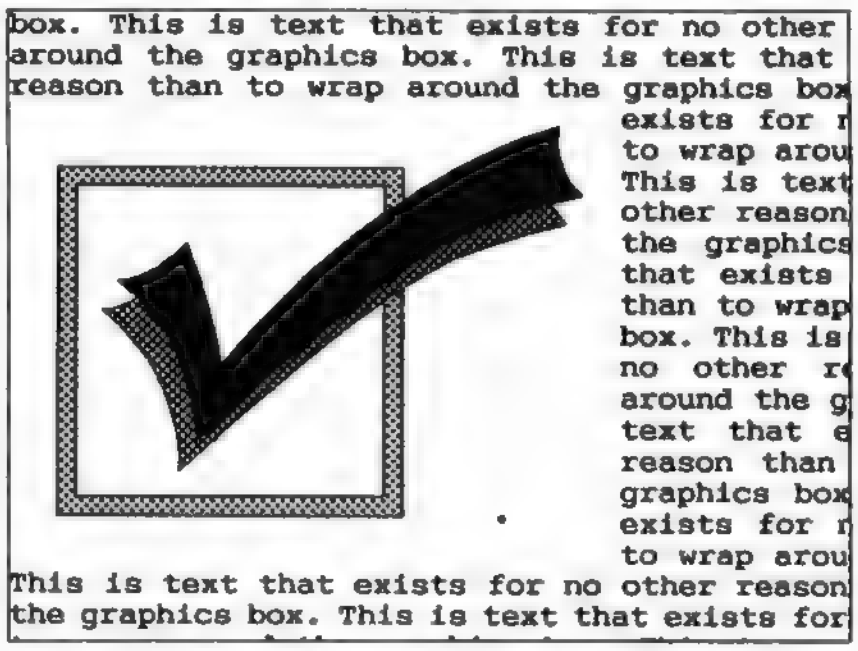

Figure 2: **If you set WordPerfect to wrap text around a graphic, it will treat the graphic as if it has straight edges, no matter how irregular they are.**

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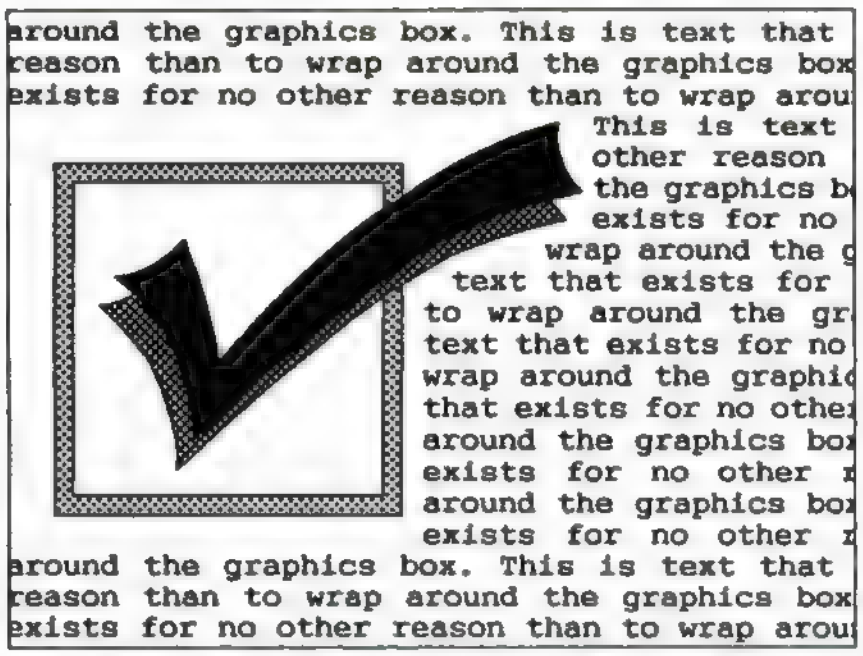


Figure 3: **You can get a more professional look than in Figure 2 by letting the text follow the shape of the graphic. The trick is to tell WordPerfect to overwrite the graphic you see and then add some invisible graphics to define the edges.**

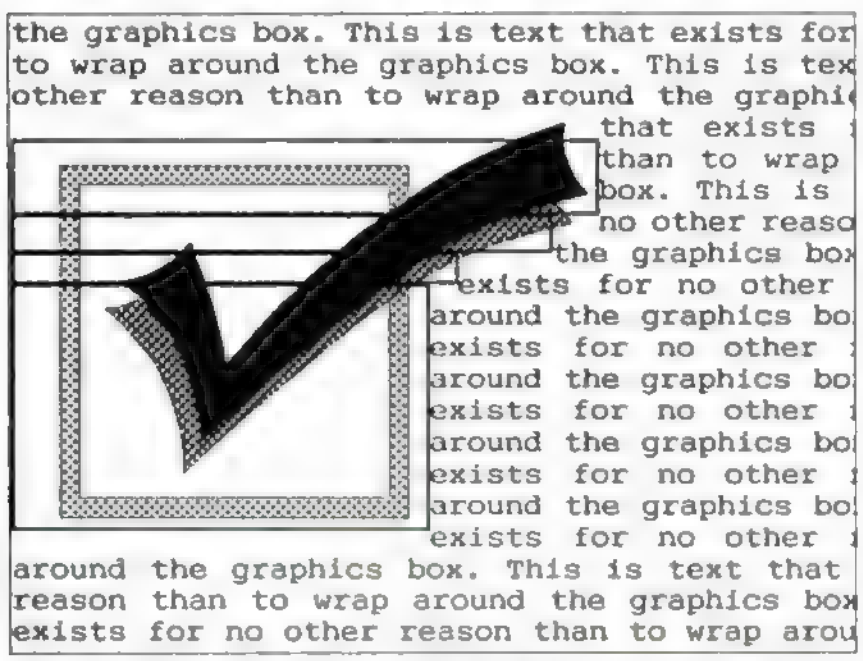


Figure 4: **This sample is the same as in Figure 3 but with the "invisible" graphics now showing, simply by printing the outline of their borders. Note that these box types are set with an outside border that pushes text further away.**

Figure 2, with the checkbox graphic defined to be overwritten by text and with four invisible figures added to define the border. Figure 4 shows the same graphic again, but with the "invisible" figures set to print a single-line border.

Ralph Quarles
Palmdale, California

▶PC MAGAZINE: While the concept is simple and steps for accomplishing it are reasonably straightforward, this can be a tedious workaround, particularly if you have a graphic with many irregularities in its shape.

If you try this approach, you'll have to adjust position, width, and height for the graphics box at least partly by eye. Be prepared for a fair amount of trial and error, moving back and forth between the Figure or Box settings screen and print preview. (To reach the settings screen, press Alt-F9, then choose a Figure or Box option, then Edit, and designate the Figure or Box number. For print preview, press Shift-F7, View Document.)

Fortunately, there are one or two simple steps you can take that may help minimize the trial and error. First you'll want to make sure that the options for the Figure or Box type you're using are set the way you want them. If you plan to use the Figure type, for example, first choose Alt-F9, Figure, Options, and set Border Style to None.

You may also want to make sure that inside and outside borders are set to 0 inches on the Options screen. This will make it easier to calculate the height and width for each Figure or Box. For example, if your text is 6 lines per inch and you want a given Box to be 4 lines high, you'll want to set the height for that Box to 0.668 inches (6 lines per inch equals ⅙, or 0.167 inches per line, times 4 lines equals 0.668 inches). Such dead reckoning will get you close, but you'll still need to check out the result by eye.—*M. David Stone*

SHARING DICTIONARY FILES

TIP The spell-checking features in Word for Windows 2.0 and Excel 4.0 are so similar that it occurred to me that they might actually be interchangeable. The prospect of this appealed to me: It would mean that not only could I regain some hard disk space by eliminating a redundant program, but also that I could share the same custom dictionary for both applications.

A little investigation showed that WinWord's spell-checking files, SPELL.DLL and SP_AM.LEX, are located in the WinWord directory, while Excel's files, MSSPELL.DLL and MSSP_AM.LEX, are located in the \WINDOWS\MSAPPS\PROOF directory. To find out whether the two sets of files were interchangeable, I made two changes to the Word section of WIN.INI. The section is identified with the header [Microsoft Word 2.0]. In it, you will find a line similar to this:

```
Spelling1033,0=C:\WINWORD\
SPELL.DLL,C:\WINWORD\SP_AM.LEX
```

(This example assumes that you have installed WinWord directly off the root directory on the C: drive. If you have installed the program elsewhere, the path will be different.)

To tell WinWord to use the Excel spell-checker feature, you only need change the path and filename information to specify the Excel files. In this case, assuming that Windows is on your C: drive also, you would change the line to read

```
Spelling1033,0=C:\WINDOWS\MSAPPS\
PROOF\MSSPELL.DLL,C:\WINDOWS\MSAPPS
PROOF\MSSP_AM.LEX
```

This is the exact same line that you'll find in the [MS Proofing Tools] section of WIN.INI.

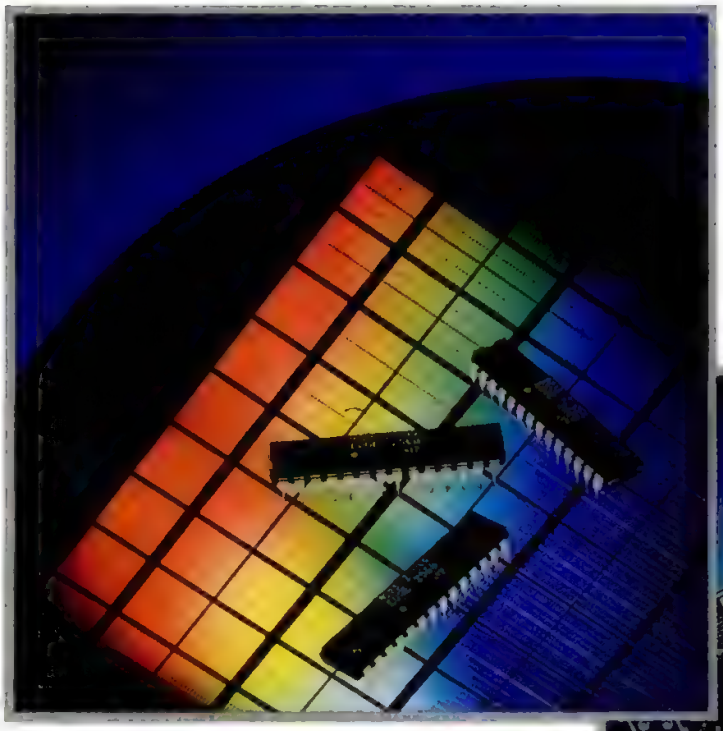
Once you've set WinWord to use the Excel spell-checking files, you will find that any words you add to the custom dictionary in either program will be available to both.

The technique seems to work, and I haven't run into any obvious problems. However, I'm still half expecting something to go wrong: While the files seem equivalent, the fact that they're two different sizes indicates at least some difference. Is there a hidden problem in sharing the spell-checking features this way? If there is, then can Excel at least share the custom dictionary with WinWord?

John Wu
San Luis Obispo, California

▶PC MAGAZINE: You've found a technique that Microsoft documents—though with less than ideal clarity—in its Knowledge Base on CompuServe. If you'd like to explore the Knowledge Base, you can get there by entering GO MSKB from the CompuServe command line prompt. The entry that discusses this technique is Document Number Q84334, "Using Excel's Dictionary Files with Word for Windows."

STEP UP TO THE EDGE...



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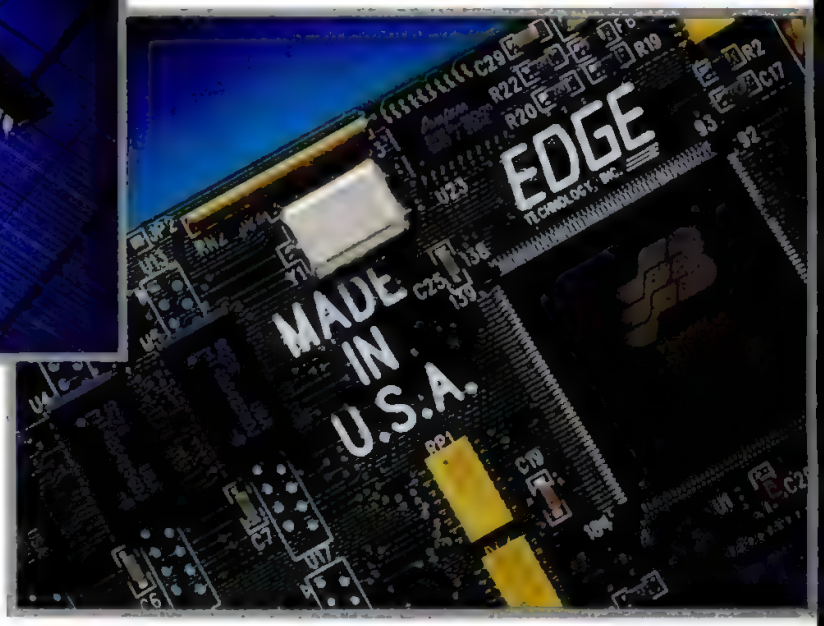

LIGHTNING VIDEO PERFORMANCE

Using 2nd generation GUI Accelerators like S3's new 86C924 combined with AT&T's 24-Bit True-Color RAMDAC and 1MB of VRAM, our engineers have developed the V24 BitBlaster, providing 16.7 million simultaneous colors with significant performance improvements over earlier S3 based designs.

Upgrade your existing PC for only $199

486SX•25 UPGRADABLE

- Intel 486DX2 50MHz Upgradable
- Intel 486SX 25MHz Processor 8K Cache w/CoProcessor Socket
- 4MB of High Speed RAM
- 130MB 15ms IDE Hard Drive
- 1.44MB and 1.2MB Floppy Drives
- D24 BitBlaster GUI Accelerator 24-Bit True-Color w/ 1MB RAM, 16.7 Million Simultaneous Colors, Up to 1280 x 1024 Resolution
- Non-Interlaced 14" Super VGA Color Monitor, .28mm Dot Pitch 1024 x 768 Resolution, VESA
- Logitech Mouse and Pad
- 1 Parallel, 1 Game, 2 Serial Ports
- 101-Key Keyboard (130-Key Opt.)
- Microsoft DOS 5.0 Pre-loaded

486SX•33 LOCAL BUS +$200
w/256K 17ns Static RAM Cache

$1399

486SX•25	80MB	130MB	213MB
14" SVGA 1024I	$1,269	$1,319	$1,469
14" SVGA 1024NI	$1,349	$1,399	$1,549
15" SVGA 1280NI	$1,549	$1,599	$1,749

486DX•33 LOCAL BUS

- Intel 486DX2 66MHz Upgradable
- Intel 486DX 33MHz Processor 8K Cache and Math CoProcessor
- 256K 17ns Static RAM Cache
- 8MB of High Speed RAM
- 130MB 15ms IDE Hard Drive
- 1.44MB and 1.2MB Floppy Drives
- D24 BitBlaster GUI Accelerator 24-Bit True-Color w/ 1MB RAM, 16.7 Million Simultaneous Colors, Up to 1280 x 1024 Resolution
- Non-Interlaced 14" Super VGA Color Monitor, .28mm Dot Pitch 1024 x 768 Resolution, VESA
- Logitech Mouse and Pad
- 1 Parallel, 1 Game, 2 Serial Ports
- 101-Key Keyboard (130-Key Opt.)
- Microsoft DOS 5.0 Pre-loaded

486DX2•50 +$200

$1899

486DX•33	130MB	213MB	340MB
14" SVGA 1024NI	$1,899	$2,049	$2,399
15" SVGA 1280NI	$2,399	$2,249	$2,599
17" SVGA 1280NI	$2,699	$2,849	$3,199

486DX2•66 LOCAL BUS

- Intel 486DX2 66MHz Processor 8K Cache and Math CoProcessor
- 256K 17ns Static RAM Cache
- 8MB of High Speed RAM
- 213MB 15ms IDE Hard Drive
- 1.44MB and 1.2MB Floppy Drives
- D24 BitBlaster GUI Accelerator 24-Bit True-Color w/ 1MB RAM, 16.7 Million Simultaneous Colors, Up to 1280 x 1024 Resolution
- Non-Interlaced 14" Super VGA Color Monitor, .28mm Dot Pitch 1024 x 768 Resolution, VESA
- Logitech Mouse and Pad
- 1 Parallel, 1 Game, 2 Serial Ports
- 101-Key Keyboard (130-Key Opt.)
- Microsoft DOS 5.0 Pre-loaded

486DX2•66 EISA +$200

$2499

486DX2•66	130MB	213MB	340MB
14" SVGA 1024NI	$2,349	$2,499	$2,849
15" SVGA 1280NI	$2,549	$2,699	$3,049
17" SVGA 1280NI	$3,149	$3,299	$3,649

UPGRADES

16MB Upgrade $199
Upgrade from 8MB to 16MB

8MB Upgrade $99
Upgrade from 4MB to 8MB

V24 BitBlaster $99
S3 86C924 GUI Accelerator, 16.7M simultaneous colors, up to 1280x1024 resolution

FAX /Modem 9624 $49
Send & receive w/MNP5 and QuickLink II

250MB Tape Drive $199
Colorado Jumbo 250MB Tape Backup with QIC 40

CD-ROM Drive $299
w/ Microsoft Bookshelf
Encyclopedia, Dictionary, Thesaurus and Almanac

Upgrades available at time of system purchase only.

CALL FOR CUSTOM NETWORK SERVER CONFIGURATIONS

OF TECHNOLOGY

THE PRICE/ PERFORMANCE LEADER

The two basic questions most people ask themselves when buying a computer are "How much bang for the buck?" and "What about service and support?". Unfortunately most computer companies do an adequate job of only one or the other. Edge provides you with the highest price / performance value available without sacrificing the service and support you deserve. You no longer have to choose one or the other.

AWARD WINNING COMPONENTS

In addition to our Ultra-Fast 17ns SRAMs and high performance board level products, we use award winning brand name components like genuine Intel processors, MAG Innovision monitors, Maxtor hard drives and Logitech mice.

LOGITECH MAG INNOVISION Maxtor intel inside

486DXL COLOR NOTEBOOK

800-GET-EDGE

- Intel 486DXL 25MHz Processor
  8K Cache and Math CoProcessor
- 4MB of High Speed RAM (to 16MB)
- 80MB Removable Hard Drive
- Color VGA Display 640 x 480
- Dimensions: 9.4" x 12.2" x 2"
- Weight: 7.1 lbs with Battery
- Suspend / Resume Feature
- Full Size 86-Key\Keyboard
- 1.44MB 3.5" Floppy Drive
- Advanced Power Management
- 1 Parallel, 1 VGA, 2 Serial Ports
- A/C Charger / Adapter
- Carrying Case Included
- Microsoft DOS 5.0 Pre-loaded

EDGE 425CN

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- ONE YEAR ON-SITE SERVICE OR SYSTEM REPLACEMENT

ON-SITE SERVICE

EDGE TECHNOLOGY, INC.

$2999

NOTEBOOK UPGRADES	
120MB Hard Drive	$199
[illegible] Upgrade	$199
Upgrade from 4MB to 8MB	
Fax/Modem 9624	$99

MON-FRI 7AM - 7PM,
SAT 8AM - 2PM(MST)

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CIRCLE 119 ON READER SERVICE CARD

According to the Knowledge Base entry, Excel cannot use the WinWord 2.0 or 2.0a spell-checking files SPELL.DLL and SP_AM.LEX. But WinWord can indeed use the spell-checking files that ship with Excel 4.0. These same files also ship with Publisher and Works for Windows.

Aside from file sizes, the key difference between the two spell-checking features is that the WinWord version allows exclusion dictionaries, while the Excel/Publisher/Works version does not. An exclusion dictionary lets you specify words that WinWord should not accept as spelled correctly, even though the word is spelled that way in the standard dictionary. For example, the WinWord spell-checker will accept *judgment*, but not the alternate spelling *judgement*. If you prefer the second spelling, you can add it to your custom dictionary so it won't be flagged. Then, to ensure consistency in your documents, add the first spelling to your exclude dictionary so that it *will* be flagged. But since few people use the exclusion dictionary in any case, this isn't much of a loss.

To sum up the discussion to this point: You can modify the Spelling line in the Word 2.0 section of your WIN.INI file, then use Excel's spell-checking files with WinWord (and with any other Microsoft programs that use those files) without problems. And you can regain some space by deleting the SPELL.DLL and SP_AM.LEX files from your WinWord directory. However, there are some complications you need to be aware of.

Since one point of this endeavor is to have WinWord and Excel both use the same custom dictionary (or dictionaries), you have to set both programs to look for these dictionaries in the same place. The setting for Excel is in the EXCEL4.INI file, which the Excel setup program should have created in your Windows directory. The default path is the \WINDOWS\MSAPPS\PROOF directory, and your EXCEL4.INI file should have a section labeled [Spell Checker] that includes the appropriate line. Assuming you installed Windows on drive C:, the line should read

```
Custom Dict 1=C:\WINDOWS\MSAPPS\PROOF\
CUSTOM.DIC
```

The equivalent line for WinWord takes exactly the same form, but goes in the WIN.INI file in the section labeled [MS Proofing Tools].

WinWord will automatically enter the line in WIN.INI the first time you use the custom dictionary. However, depending on the version you first created the custom dictionary with, WinWord may have placed the dictionary in either the \WINDOWS\MSAPPS\PROOF directory or the WinWord program directory, and then set the path accordingly in the WIN.INI file. (The default path for the custom dictionary varies with the version of WinWord and whether the program finds a custom dictionary already located in either of the two directories.)

In any case, it's easy enough to check WinWord's setting for the custom dictionary. Simply look in the WIN.INI file under the [MS Proofing Tools] section. Alternatively, you can open WinWord, choose Tools Options, then WIN.INI. Enter MS Proofing Tools in the Application text box and look for the setting for the Custom Dict 1 option. You can also change the path from this screen by typing it into the Setting text box and choosing Set.

If you don't yet have any custom dictionaries (or you have only one and it was created in either Excel or WinWord 2.0a), then once you're sure that both programs are set to use the same custom dictionary, you just need to make sure it's in the \WINDOWS\MSAPPS\PROOF directory. If you have dictionaries from each program or one dictionary created in WinWord 2.0, you have one more step to go.

If you're using WinWord 2.0, rather than 2.0a, you'll find that the Excel spell-checking files won't work with the 2.0-format custom dictionary because Version 2.0 sorts words differently than 2.0a or Excel. Excel will simply refuse to start to spell-check if it finds a Version 2.0 CUSTOM.DIC file. WinWord 2.0, using the Excel spell-checking files, will give an error message with a 2.0 CUSTOM.DIC.

The easiest way to convert a 2.0 custom dictionary is simply to open the file in either WinWord or Excel and run a spell-check on it, accepting all the words.

Similarly, if you have one custom dictionary from each program, you'll want to integrate the two. Here again, the simplest approach is to spell-check one of the files, in this case making sure the other file is in the \WINDOWS\MSAPSS\PROOF directory first. If one of the files was created with WinWord 2.0, that's the one you'll want to spell-check. Otherwise, spell-check the one with fewer words.

—*M. David Stone*

Spreadsheets

START WITH A MAXIMIZED SHEET

TIP On the whole, I find Excel (especially Version 4.0) powerful and easy to use. However, one niggling irritation remains: When the program starts, the default Sheet1 window is not maximized. If you do not maximize it yourself manually, when you load a new worksheet, it too will not be maximized.

There are workarounds for this in both Versions 3.0 and 4.0. In Excel 3.0, it was easy. All you had to do was maximize the Sheet1 window when the program loaded and then save this workspace (say, as RESUME.XLW) in the \EXCEL\XLSTART directory. Because Version 3.0 workspaces remembered their window sizes, whenever the program loaded, the default window would be automatically maximized for you.

In Excel 4.0, things got more complicated. Version 4.0 introduced workbooks, which had the same .XLW extension as the old Version 3.0 workspaces. Workspaces as such are no longer available. In Version 4.0, if you save a workbook with a maximized window as \EXCEL\XLSTART\RESUME.XLW, you have problems. The workbook remembers its component window sizes and lo-

MAX.XLM

Complete Listing

	A	B
1	Auto_Open	
2	=NEW(1)	Open a new sheet...
3	=WINDOW.MAXIMIZE()	...and maximize it
4	=RETURN()	

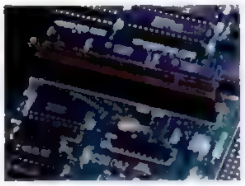
Figure 5: **This simple Excel 4.0 macro, when kept in a file in the XLSTART directory, will maximize your spreadsheet on start-up.**

FastMicro Finally Puts the 486 in Its Rightful Place!

Inside the New FastMicro 486/Pro!

Dual VESA Standard!

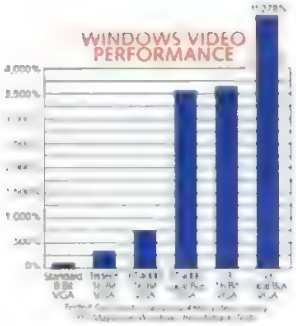
Settle for everything! While a few computer companies give you VESA local bus and even fewer give you a VESA standard monitor, FastMicro includes both!



VESA Standard Local Bus!

Why settle for slow video performance? FastMicro includes a high performance Windows accelerator combined with a VESA standard local bus!

Why is Local Bus faster? The i486DX is a high speed (33+ MHz) 32 bit processor. Video cards plug into a slot in your PC, called a bus connector. The standard PC bus was designed for an 8 MHz 286, therefore it's confined to 8 MHz and 16 bit. FastMicro's VESA Local Bus runs at 33MHz and 32 bit. Turn on your 486/Pro and watch Windows scream!



Why VESA? VESA Local Bus is a standard, unlike a proprietary local bus. You can upgrade your system in the future with third party VESA standard local bus peripherals. With your 486/Pro from FastMicro, you're not locked in.

Plus True Color Video!

No video card delivers more! FastMicro gives you the maximum number of colors possible for scanning, graphics, presentations and desktop publishing. Many systems can only do 256 colors, some can do 32,000 colors, FastMicro takes you to the limit with 16.7 million colors maximum!

FastMicro Combines VESA Local Bus Performance with Windows Acceleration & over 16 Million Colors!

VESA Standard Flicker-Free Monitor!

Non-Interlaced monitors are not created equal. A non interlaced monitor with less than a VESA standard refresh rate will flicker at high resolution modes! The resolution is the number of pixels (or 'dots') on the screen, the refresh rate is the speed in which the monitor redraws the screen. Don't be fooled.

VESA Standard Refresh Rates at 640x480, 800x600, & 1024x768!

Your new 486/Pro system from FastMicro includes VESA standard refresh rates at 640x480, 800x600, and 1024x768! Compare and don't settle for less, if other systems don't say it, they won't do it!

20% Larger Display with Edge-to-Edge Video!

In addition to eliminating annoying flicker when running in high resolution modes, FastMicro doesn't make you look at tiny characters either! Our new VESA standard display includes Edge-To-Edge video! 14" monitors are not created equal. You see, 14" is strictly the tube size, not the display area. FastMicro 486/Pro monitors are user adjustable for width, height, and position - just set to your preference and forget it.

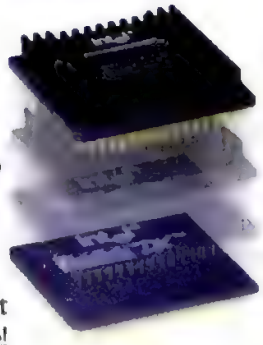
Standard Non-Interlaced Monitors

FastMicro Edge-To-Edge Video!

You get more useable screen area than many 15" monitors. Edge-To-Edge video is really a lifesaver when running at 800x600 or 1024x768 Super VGA modes!

FastMicro Maximizes Performance

Advanced Upgrade Path!

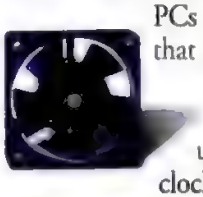


Not only do you get a high performance 486 PC today, but you can upgrade it tomorrow! Put a 33MHz FastMicro 486/Pro system on your desk and when you're ready for even more power, you can pop in an Intel OverDrive™ processor and boost performance even more!

Your 486/Pro system is compatible with Intel's fastest processors so you're assured of state of the art performance now and a growth path tomorrow!

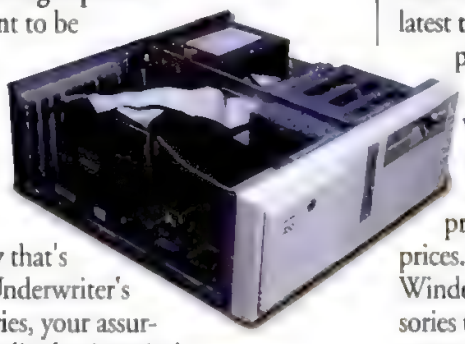
Dual Intelligent Cooling Fans: Only from FastMicro!

Every desktop FastMicro PC comes with dual cooling fans. It has a main fan that's quieter than fans in ordinary PCs - plus it includes a special second fan that comes on only when the system gets warm. A cooler system lasts much longer - a concern particularly when upgrading to higher heat-producing clock doubler chips.



Fourth Generation Case

Our desktop case is uniquely engineered to provide the highest quality and maximum expandability in a space saving design. It has a total of seven drive bays to accommodate all of the storage options our customers tell us they want to be able to add in the future. It also has extra protection against electrical interference, unlike the weaker systems others sell. It also includes a power supply that's listed by Underwriter's Laboratories, your assurance of quality by America's most prestigious safety organization.

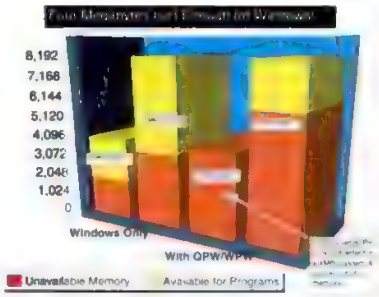


Conner 212Mb Higher Performance Drive.

FastMicro ups the ante with Conner's CP-30204 212mb IDE hard drive standard in 486/Pro systems. Conner has a reputation for building the most reliable drives on the market. Couple this with a 12 millisecond access time and up to 8MB/sec. data transfer rate and you won't want to gamble on a less reputable drive. No wonder Conner is now the #1 manufacturer of hard disks in the world!

Eight Megabytes of Memory!

Running Windows? Don't run out of memory! When Windows runs low on memory, it starts using your hard drive like memory. Memory is 200+ times faster than a hard drive - don't get caught short! FastMicro includes a full eight megabytes of RAM in every 486/Pro system.



Start with FastMicro, Stay with FastMicro.

Why call one company to order your PC and another for everything else? FastMicro is the only leading system vendor that also advertises a full line of software, peripherals and more to complete your system and keep you abreast of all the latest technology products to maximize your computing productivity.

Four times a year, we'll send you our informative catalog featuring over five hundred PC products at low FastMicro prices. It features everything from Windows software to books, accessories to networking, and printers to games. FastMicro is truly your one-stop shop!

FastMicro 486/Pro Series - Don't Settle for Less!

4DX/33 $1999

4DX2/66 $2399

- VESA Local Bus SVGA Windows Accelerator Card with 16.7 Million Colors Maximum.
- VESA Standard Non-Interlaced 14" Super VGA color monitor with 800x600 @ 72hz & 1024x768 @ 70hz and Edge-To-Edge Video.
- Dual Intelligent Cooling Fans.
- Clock calendar, parallel port, game port and two serial ports.
- 8 expansion slots, 2 occupied.
- Fourth Generation Desktop Case.
- 200 Watt UL Listed Power Supply.
- Microsoft DOS.
- Microsoft Windows 3.1
- Microsoft Serial Mouse.
- Choice of Two Major Software Applications: WordPerfect for Windows, Quattro Pro for Windows, Paradox, PC Tools and/or Graphics Works for Windows.
- FastMicro Peace of Mind.

- i486™ Processor with 8K Internal Cache.
- High Speed 128K External Static RAM Write-Back Cache.
- Upgradable to Overdrive Processors.
- 8 megabytes of high speed RAM.
- 212mb 12ms Conner IDE hard disk.
- 1.2mb 5.25" & 1.44mb 3.5" Toshiba floppy drives.

Legendary FastMicro Service

FastMicro backs up all FastData PC's with the most comprehensive service in the business. Seven day a week toll-free technical support is included for as long as you own your FastData PC. In the unlikely event a part should fail during the one year warranty, we'll express ship you the replacement part. If we still can't resolve the problem, we'll send GE on-site or replace the system at no charge.

GE Computer Service

Satisfaction Guaranteed

We'd love to add you to the FastMicro family of satisfied customers. Every FastData 486 PC comes with our 30 day money back satisfaction guarantee.

But if you're like the majority of our customers, you'll be very satisfied. After all, at FastMicro, we want you as a customer for life - not just today.

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FASTMICRO 1-800-824-6000

Folded edge of the page

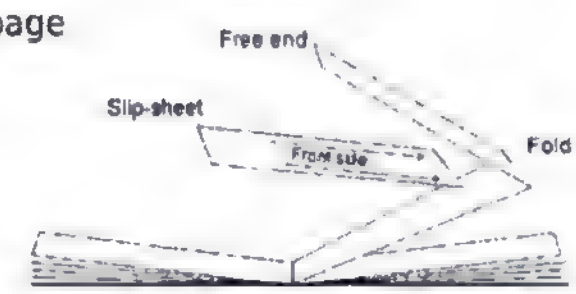
Foldout slip-sheet

GbsSlipSheet-001

Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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   1. Front side touching the free page
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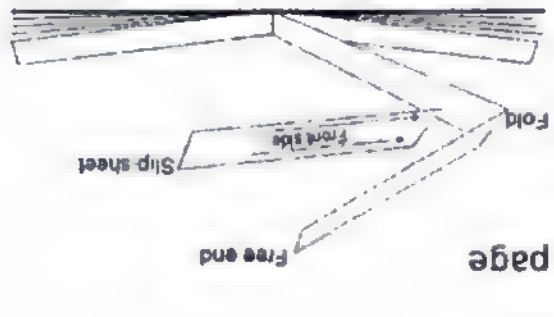


Inverted Back

1. Follow instructions on the other side

GbsSlipBack-0018

Back

1. Follow instructions on the other side

High Performance Software Included Too!

Start with Windows & a Genuine Microsoft Mouse!

With FastMicro 486/Pro systems you get more! Of course you get the latest versions of Microsoft DOS and Windows preinstalled. But unlike most of our competitors, we include a true Microsoft mouse, not the lowest price mouse we could find.

Take Two - Get up to $700 Worth of Software

The best computer deserves the best software and FastMicro includes some of today's hottest software at no extra charge! Choose any two of the following titles and you'll get the latest versions complete and ready to run. Everything's included and you get full manufacturer support (unlike some other 'bundles'). The products come in special FastMicro boxes - retail boxes shown.

WordPerfect for Windows

WordPerfect is the #1 selling word processing software and the Windows version is loaded with features. It includes the ability to create & edit tables, equations, lists and graphics. You can even edit graphics created with other programs! Plus, it works with your WordPerfect for DOS files and uses familiar WordPerfect commands so your transition to Windows is easy.

PC Tools 8.0

The latest version of the top selling utility software! PC Tools 8.0 adds an all new DOS desktop with integrated application menu & manager, file viewer & manager, scheduler, and desk accessories. You also get Central Point's award-winning backup and a hot new version of Anti-Virus. PC Tools also includes DiskFix, FileFix, Undelete, Unformat, Disk Edit, Defragmenter, Cache and more! Central Point Commute lets you remotely run Windows or DOS applications and you get new RamBoost Memory Optimizer too!

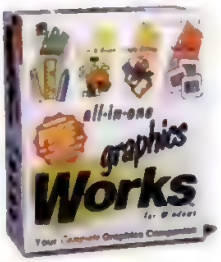
Quattro Pro for Windows

"Quattro Pro for Windows is worth the wait" proclaims PC Magazine. QPW uses spreadsheet notebooks to easily organize your spreadsheets. Click your right mouse button and Object Inspectors lets you change attributes instantly! Speedbars give you those one-click shortcuts that change depending on what you're working on! Interface Builder lets you build applications without programming. "QPW comes with a separate Database Desktop application -a beautifully designed query-by-example tool" says PC Magazine, "QPW's graphs are gorgeous and include rotatable 3-D types as well as options to adorn them." Need we add more?

Paradox 4.0

Paradox is the most advanced relational database ever created for the PC. Now it's the fastest. For first time users or application developers, Paradox provides the ease of use and power you need! New Application Workshop, Paradox's application generator, lets you easily develop custom applications. Paradox also has automatic multiuser support and is network ready. Combine this with the full suite of development tools and SQL connectivity and Paradox is the database of choice!

Graphics Works for Windows



With five applications in one, Graphics Works from Micrografx gives you complete graphic tools for Windows. Includes Windows Draw! - the hot selling package that lets you create graphics compatible with your other Windows programs. It also includes new Photo Magic! - the photo editing software that comes with hundreds of photos you can or modify and use in you documents (plus you'll have photo realism on-screen with FastMicro's true color video). You get a charting tool and the leading organization charting software for Windows. Plus you get a bonus CD with over 1,000 photos and 10,000 pieces of clip art you can use as-is or customize with Graphics Works!

Why settle for less?
FastMicro includes the real thing: a Microsoft Mouse.

True Intel 486 for Less Than $1,000!

Introducing FastMicro's 486/Valueline.

intel inside

Don't need all the extra features of our 486/Pro Series? Then the 486/Valueline is right for you. This system is truly a price breakthrough! FastMicro delivers a high performance 486 system at a low end price. Others can only offer a 386/SX for less than $1000 or substitute an imitation 486 that's more like a 386, FastMicro puts 25MHz 486SX power in your hands. Plus this isn't a 'bare' system, you get a system that's complete and ready-to-run right out of the box, including a Super VGA color monitor and card.

Loaded with Memory & Storage

CONNER

FastMicro also includes four full megabytes of high-speed SIMM memory! You can even expand the memory to a total of 32MB. Of course, how can you also expect to get a hard drive at this price? Well, FastMicro includes a quality Conner hard drive with an unbelievable 85MB capacity. Plus, since it's a standard IDE drive, you can easily add a second hard drive later.

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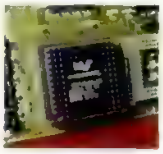

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MAXIT.XLM
Complete Listing

	A	B
1	Auto_Open	
2	=ON.TIME(NOW()+0.000001,"Maxit")	Provides delay to let startup sheet(s) arrive
3	=RETURN()	
4		
5	Maxit	
6	=IF(COLUMNS(DOCUMENTS())=1,NEW(1))	Opens new sheet if only this macro sheet is present
7	=WINDOW.MAXIMIZE()	Max it!
8	=RETURN()	

***Figure 6:* This Excel macro does the same thing as the one in Figure 5, but it also lets you start Excel with a specified filename.**

cations, so Excel starts with a maximized window. But you're left with Sheet1 residing within a workbook named Book1. If you make any changes to Sheet1 and then save the file, you also have to first remove Sheet1 from Book1. Alternatively, if you choose File New Worksheet, you get a second file named Sheet1. Now you have one Sheet1 residing within Book1 and a new one in its own right.

Fortunately, there is another way to maximize windows on start-up in Excel 4.0. All it takes is a simple Auto_open macro stored in Excel's global macro sheet, GLOBAL.XLM. The macro needs only a label and three lines of code, as shown in Figure 5.

If you don't already have a global macro sheet, just open a new macro sheet, name it GLOBAL.XLM, and store it in your XLSTART directory. If you make GLOBAL.XLM a hidden window, then all you see on start-up is the blank maximized worksheet. After you enter the macro code in GLOBAL.XLM, hide it with the Window Hide command and quit Excel. Answer yes when Excel asks if you want to save the changes in GLOBAL.XLM. All your future Excel sessions will then start with a maximized blank worksheet.

Russell Clarke
Noble Park North, Victoria
Australia

▶PC MAGAZINE: Mr. Clarke's simple macro actually doesn't have to be kept in the global macro sheet. You could put it in any macro sheet that's stored in your XLSTART directory. Excel loads all worksheets, charts, and macro sheets stored in XLSTART each time you run the program. But GLOBAL.XLM will do nicely. If you have already recorded some global macros, you'll find your GLOBAL.XLM sheet by using the Unhide command. Just make it visible, add Mr. Clarke's worksheet maximizer, and then rehide.

I have one small modification to suggest. As presented by Mr. Clarke, the macro always loads and maximizes a new worksheet, even if you happen to start Excel with a command line parameter.

Ordinarily, if you start Excel by choosing Program Manager's File Run command and typing EXCEL.EXE MYSHEET.XLS, you get just MYSHEET.XLS; because you specified a filename, Excel suppresses its usual blank start-up sheet. The same is true if you fire up Excel by double-clicking a Program Manager icon that has one or more worksheets named on its command line. With Mr. Clarke's macro on-board, you get the blank sheet even if you specify start-up files.

The variant shown in Figure 6 gives you a maximized start, while preserving Excel's normal Sheet1 behavior. If you launch without a command line parameter, you get a blank sheet. If you name a start-up file, you get just that file.

The version in Figure 6 uses COLUMNS(DOCUMENTS()) to determine how many document files are present. DOCUMENTS() by itself returns, as an array, the names of all open documents. COLUMNS(DOCUMENTS()) simply measures the width of that array, returning the number of open documents. If only one document is present—the maximizing macro itself—then a new sheet is opened.

The ON.TIME delay in cell A2 gives files you specify on the command line a chance to arrive before the maximizing macro does its thing. Without that delay, the Auto_open macro would always run before the command line files were loaded—and hence would always open a blank worksheet.—*Craig Stinson*

QPW PAGE NAME FORMULA

❓ In Quattro Pro for Windows, I sometimes plot graph series that cross workbook pages. For example, I might have divisional sales figures in four pages named North, South, East, and West. If I put my quarterly sales figures for each division in the same range on each page, I can easily create a graph that plots quarterly sales by division. If the sales numbers are in cells E4:H4 on each page, for example, I can specify the following series:

- A series: East..West:E4
- B series: East..West:F4
- C series: East..West:G4
- D series: East..West:H4

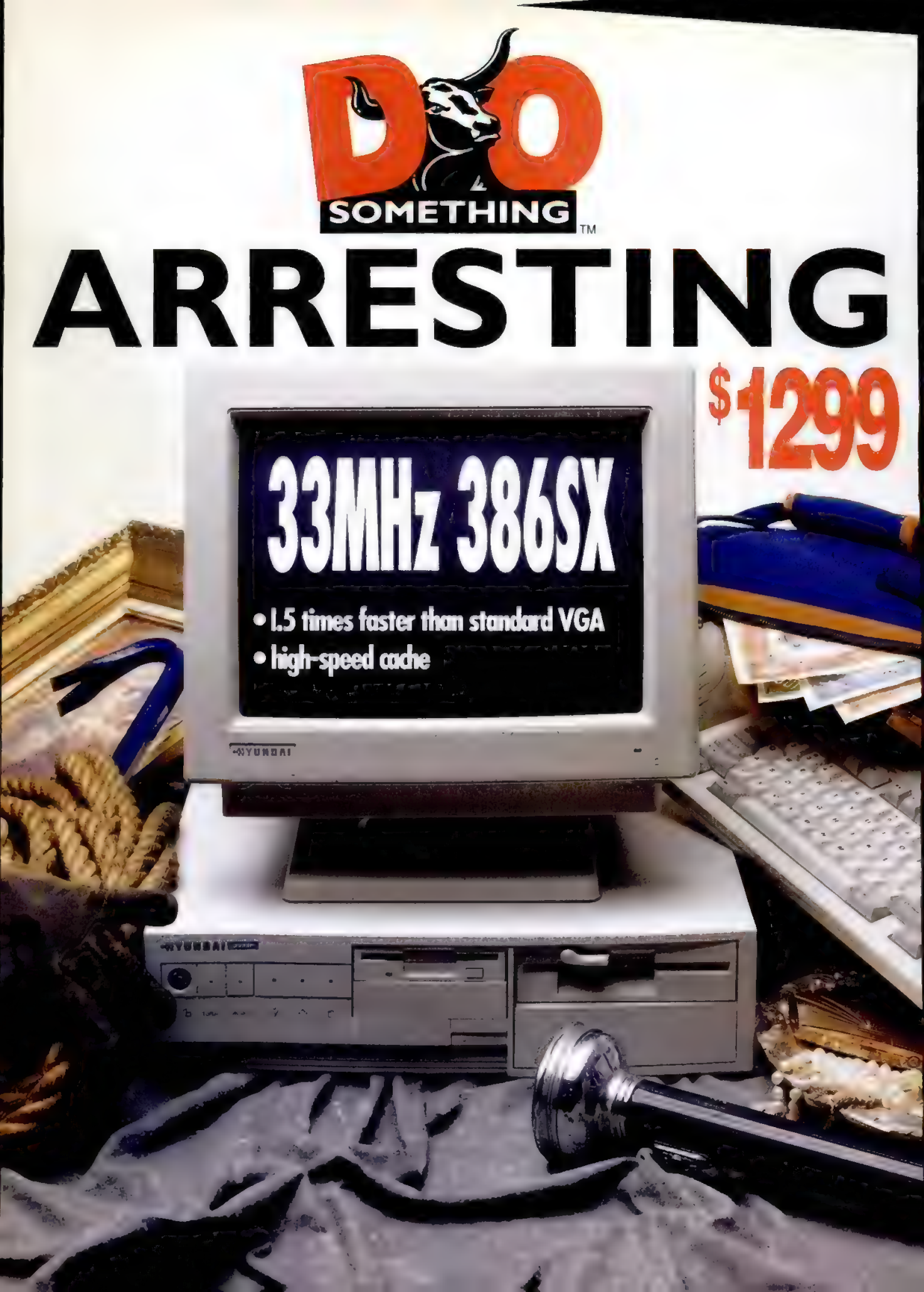
For the X series, I can type the name of each division in a common cell—say, A1—on each page. But since I've already assigned divisional names to my four pages, I wanted QPW to pick up those page names automatically for the X series. There isn't any direct way to tell QPW to look at the page-name property, but I have found that the following formula does the trick

```
@RIGHT(@LEFT(@CELL("FullAddress",
A1),@FIND(":",@CELL("FullAdress",
A1),0)),(@FIND(":",@CELL
("FullAddress",A1),0)-@FIND("$",
@CELL("FullAddress",A1),0)-1))
```

This formula returns the name of the page in which it is placed. By entering it in any cell on my first page, then copying it into the same cell on each additional page I use, I can create an X series that consists of the names of each of my pages. When I plot my chart, then, the page names appear as *x*-axis labels. If I decide to change the names of the pages later on, the *y*-axis labels are automatically changed as well.

H.P. Roberts
San Diego, California

▶PC MAGAZINE: QPW's @PROPERTY function can be used to determine the name of the active page. For example, if you're currently working on the page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CIRCLE 275 ON READER SERVICE CARD

named North, the formula

```
@PROPERTY("Active_Page.Name")
```

returns North, regardless of which page that formula is entered on. But @PROPERTY doesn't solve the problem addressed by Mr. Roberts's formula; it won't let you create cell labels identifying each page in your notebook.

Mr. Roberts's formula takes advantage of a new argument to the @CELL function, introduced with Quattro Pro for Windows. @CELL("FullAddress", Block) returns the full address of the upper-left-corner cell of Block, including the workbook name, the page name, and the cell coordinates. So, for example, the formula

```
@CELL("FullAddress",A1)
```

entered into any cell on the page named North in the notebook named SALES.WB1, returns

```
[SALES]$North:$A$1
```

Note that the workbook name is returned in brackets, without its path or extension, and that the page name and cell coordinates are returned as absolute references, regardless of how you write the formula. Also be aware that @CELL("FullAddress") does not return range names. A1 is always returned as A1, even if you've assigned a name to that cell.

Fortunately, the formula does return assigned page names, and as you can see by the example above, the page name will always lie between the first dollar sign and the ensuing colon. This predictable position enables you to pluck the name out with the help of @LEFT, @RIGHT, and @FIND.

As is often the case with string extractions, there's more than one way to skin this particular cat. The following variant is slightly shorter than Mr. Roberts's formulation and accomplishes the same end:

```
@MID(@CELL("FullAddress",A1),@FIND
("$",@CELL("FullAddress",A1),0)
+1,@FIND(":",@CELL("FullAddress",
A1),0)-@FIND("$",@CELL("FullAddress",
A1),0)-1)
```

I find the logic of this variation a little easier to explain, so I'll step you through my version instead of the one submitted in the letter.

Schematically, the full address of any cell looks like this:

```
[nbname]$pagename:$c$r
```

where *nbname* is the name of the notebook file, *pagename* is the name or letter designation of the current page, *c* is the cell's column letter, and *r* is the cell's row number. We don't know the length of *nbname, pagename, c,* or *r,* but we know we want all the text starting with the character after the first dollar sign and ending with the character before the colon. We also know that the position of these two landmarks can be found with the following two formulas:

```
@FIND("$",@CELL("FullAddress",A1),0)
```

and

```
@FIND(z":",@CELL("FullAddress",A1)
,0)
```

These formulas return character positions as offsets from the leftmost character in the string. That is, if the $ is the ninth character in the string, the @FIND function returns 8 because the numbering starts with 0.

The @MID function uses the following syntax:

```
@MID(string,startnumber,number)
```

and returns *number* characters beginning at offset *startnumber* within *string.* In our case, the *string* argument is given by the following line:

```
@CELL("FullAddress",A1)
```

For the *startnumber* argument, we want to supply the offset of the first character after the dollar sign. That argument therefore should be

```
@FIND("$",@CELL("FullAddress"
,A1),0)+1
```

And we want the *number* argument to be the offset of the colon minus the offset of the first character after the dollar sign. It therefore should look like this:

```
@FIND(":",@CELL("FullAddress",A1),
0)-@FIND("$",@CELL("FullAddress",
A1),0)-1
```

Putting these pieces together gives us the formula we need.

Note that these formulas—both the submitted one and my own—can also be used with unnamed pages. If you stick with the QPW's default letter names, the formulas simply return those letter names. If you subsequently assign descriptive names, the formulas will return the descriptive names.—*Craig Stinson*

Databases

ISDIR FOR XBASE

TIP I have a simple and fast way to tell if a string is a valid subdirectory name. All versions of MS-DOS since 2.0 include a NUL device. The NUL device behaves like a black hole: Redirect output into NUL, and you'll never see that output again. Another property of NUL is that it *seems* to exist in every valid directory.

The IsDir function (Figure 7) works by adding 'NUL' to the string you pass as a parameter and using FILE() to see whether the resulting filename exists. If the filename exists, then the parameter passed is the name of a valid subdirectory. Some networks and command processors other than DOS's COMMAND.COM might cause IsDir() to fail, so the routine tries to check for this possibility at the beginning.

This method of checking for NUL can also be used in batch files. For instance, I use the following line to avoid setting up my RAM drive (E:) if it hasn't been defined:

```
IF NOT EXIST E:\NUL
  GOTO NORAMDRV
```

I tested the IsDir routine with DOS 3.1 and 5.0; it works with dBASE IV and FoxPro.

Michael Leahy
Burlington, North Carolina

▶**PC MAGAZINE:** The IsDir function in Figure 7 works well on plain-vanilla non-networked MS-DOS systems. But it doesn't work well with Novell's Netware Shell loaded, and possibly other net-

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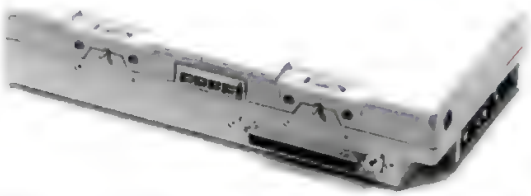

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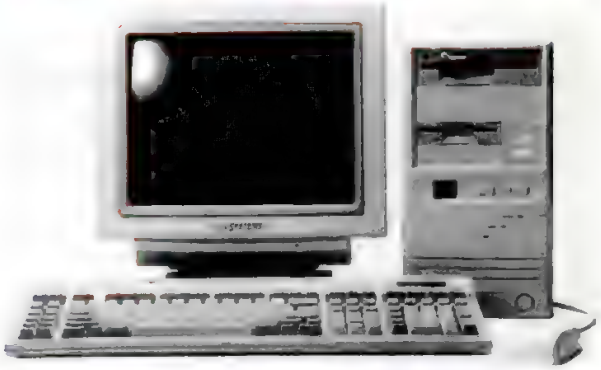

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CIRCLE 322 ON READER SERVICE CARD

ISDIR.PRG

Complete Listing

```
*****************************************************************
*  Program:  IsDir
*  Purpose:  Determines if parameter DIRNAME is a valid directory
*            name or drive designator.  Similar to FILE().
*  Example:  ? DIR('C:\DOS') or ? DIR('Z:')
*  Systems:  FoxPro, dBASE IV
*  Notes:    Not reliable on networks and on non-genuine MS-DOS
*            systems
*****************************************************************
FUNCTION IsDir
PARAMETER dirname
PRIVATE dirname, result

IF .NOT. FILE('.\NUL')
    ? 'DIR() does not work on this PC.'
    RETURN .F.
ENDIF

IF RIGHT(dirname,1) = '\'
    result = FILE(dirname+'NUL')
ELSE
    result = FILE(dirname+'\NUL')
ENDIF
RETURN ( result )
```

Figure 7: **The IsDir function uses an undocumented property of DOS to check for the existence of a directory.**

works and environments.

One of the major benefits of MS-DOS 2.0 was the appearance of installable device drivers. A device driver is a program that encapsulates all of the hardware-specific code necessary to interface to a particular device. MS-DOS has a well-defined interface through which it talks to device drivers, and it lets the device drivers handle the hardware-specific details. This means hardware manufacturers need only provide a device driver when a new hardware device is introduced. The operating system does not have to change.

When you boot up your PC, several devices are predefined by DOS and given logical names. For example, the system console (your display) is called CON and the printer is called PRN. Devices that are not built into DOS can be defined in your CONFIG.SYS file using the DEVICE= line. For instance, many systems have a DEVICE=ANSI.SYS line in CONFIG.SYS. This line tells DOS to install the ANSI device driver at start-up.

One device common to every system is the NUL device. As Mr. Leahy suggests, it's the garbage-can device. Any data sent to the NUL device is discarded. MS-DOS attempts to treat devices the same way it treats files. For example, you can use the COPY command to copy a file to your printer just as you would copy one file to another. You just substitute the name of the printer device, PRN, in place of a filename as the destination.

At a lower level, the MS-DOS routines that let you find and open a file also let you find and open a device. Instead of specifying a filename, you specify a device name. This works because DOS searches the list of devices before looking at files. If it finds a device with a matching name, it uses the device name instead. A by-product of this is that all of your named devices can be accessed as files in *any* directory of any drive. You won't see them in a DIR command, but because DOS looks through the device list first, it appears to DOS as though they exist in every directory.

Since the NUL device exists on every PC, and since DOS will find NUL in every valid directory, it can be used to test for a directory's existence. If NUL exists in a specified directory, it's a real directory. If not, the directory does not exist. The IsDir function in Figure 7 is based on this premise that NUL exists in any valid directory.

Unfortunately this is unreliable in a number of instances. For example, the IsDir function in Figure 7 will not work correctly with Novell's Netware Shell, Version 3.26 (and possibly with other versions), loaded. In my testing, the IsDir function returned .T. on network drives even for directory names that did not exist. Apparently, with the Netware Shell loaded, the FILE() function always returns .T. for a file named NUL on a network drive, even if you pass it a filespec that includes a bogus directory name ("X:\BOGUS\NUL", for example). For this reason Mr. Leahy's method of detecting situations where IsDir won't work, which relies on checking for NUL in the current directory, gives a false positive indication with the Netware Shell loaded.

If you are *not* running on a network and are running the genuine MS-DOS COMMAND.COM Shell, the function can be used with dBASE IV and FoxPro, as Mr. Leahy noted. However, if you're using FoxPro 2.0, you can use the ADIR() function instead to check for and return information on files and subdirectories. This is the preferred approach since ADIR does not rely on any of the undocumented properties of DOS.

For example, you could create a DirExist for FoxPro 2.0 as follows:

```
FUNCTION DirExist
PARAMETER cName
x = ADIR(aTemp, cName, "D")
RETURN IIF(x > 0, .T., .F.)
```

Here the ADIR() function creates and populates the aTemp array and returns the number of entries that match your file mask. If the subdirectory named in cName does not exist, the variable *x* will be set to 0 and DirExist will return false. Otherwise it will return true. Either way, aTemp is discarded.

The IsDir function shown here can be found in ISDIR.PRG on PC MagNet. Look in the Databases section of the Utilities/Tips Forum.—*Sal Ricciardi*

Graphics

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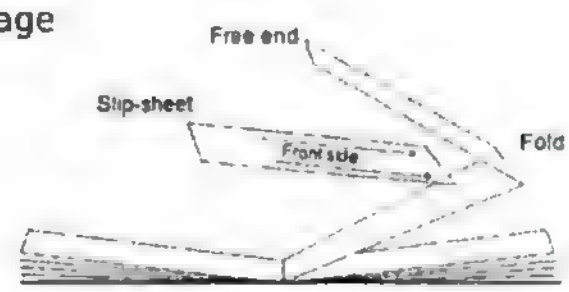
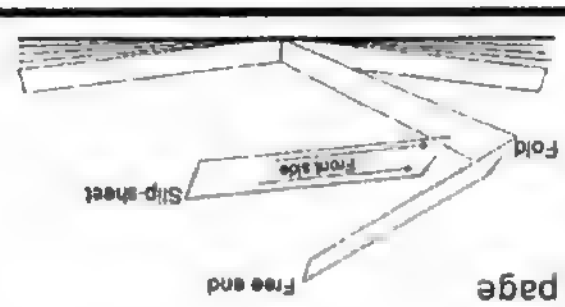
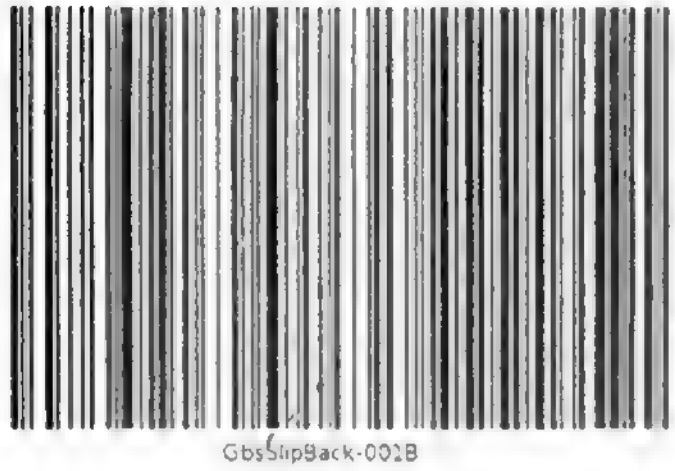
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





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1. Follow instructions on the other side

Inverted Back

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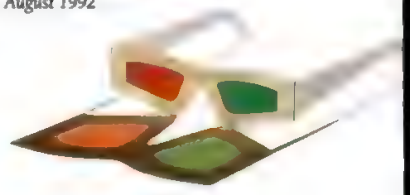

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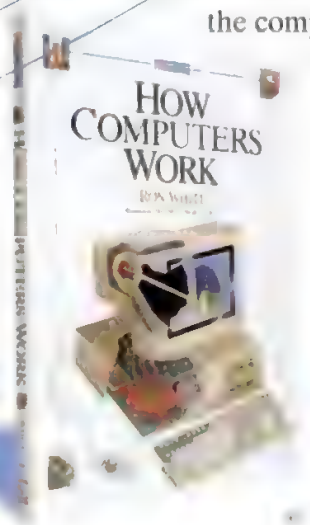

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▶PC MAGAZINE: CorelDRAW can simulate both one-point and two-point perspective, depending upon whether you drag a corner handle in a vertical/horizontal orientation or diagonally. But because the effect is applied to each object individually, it's all too easy to create inconsistencies that destroy the illusion of a unified space.

The trick to creating convincing perspective for an entire scene is the same whether you use CorelDRAW or a T-square. All the perspective lines in your drawing must converge at the vanishing point or points. Of course, Corel's electronic tools offer several improvements over conventional drafting techniques. For example, when you're using the perspective effects, CorelDRAW always displays one or two vanishing points for the currently selected object.

Here's a simple technique that will work with CorelDRAW 2.*x* or later to establish a vanishing point for Corel's perspective effects: First make sure that Show Rulers and Snap to Guidelines are turned on. Then pull one vertical and one horizontal guideline from the rulers. The intersection of the guidelines will be the vanishing point for one-point perspective.

Now you're ready to position the vanishing point. Note that you're not constrained to the physical size of your paper, because Corel's guidelines extend past the actual paper size into the surrounding pasteboard area. Select an object in your drawing, open up the Effects menu and choose Edit Perspective. To bring the object's vanishing point into view, drag an appropriate corner handle while holding down the Ctrl and Shift keys. The Ctrl key restricts your movement to either the vertical or horizontal direction—in effect holding you to one-point perspective. The Shift key moves the opposite handle the same distance but in the opposite direction.

CorelDRAW literally marks the vanishing point of each object with an x. To align the current object with the vanishing point, simply drag the x to the intersection of the guidelines as shown in Figure 8. Repeat this procedure for any other objects in your drawing that should recede toward the same vanishing point.

Linear or one-point perspective is the most common illusionistic device, but it isn't adequate for more complex drawings. With a little planning, the technique described above will work with two-point perspective: Simply pull out the necessary additional guidelines. But if you really need a perspective grid, you can take advantage of a feature hidden within CorelDRAW 3.0's new layer manager. One of the default layers is devoted entirely to guidelines, and the guidelines you draw on this special layer are not restricted to horizontal or vertical orientations. In fact you can draw an entire perspective grid—complete with diagonal, oblique, or even curved lines. Because these are true guidelines—in the sense that your cursor will snap to them—they will assist you in creating totally realistic 3-dimensional space.—*Luisa Simone*

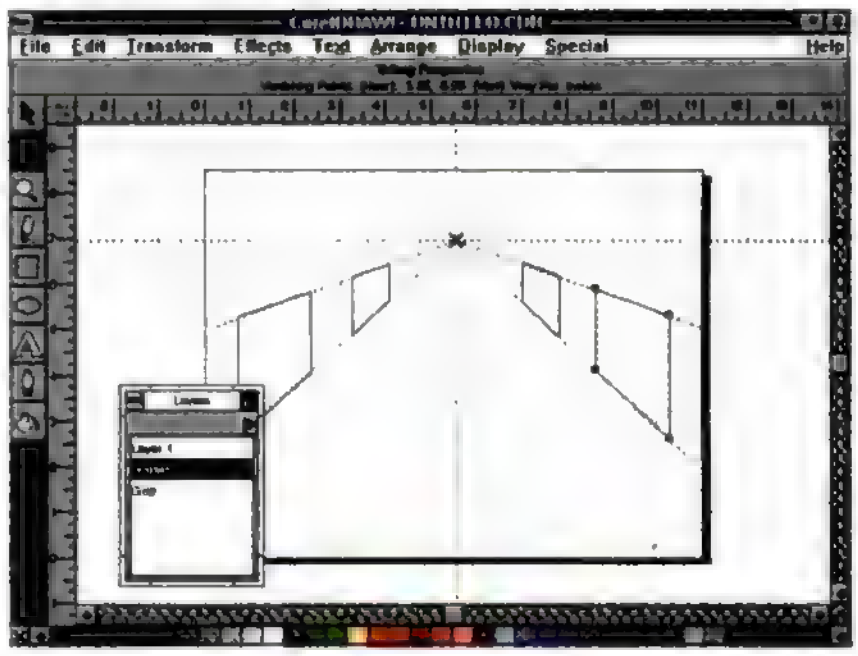

Figure 8: **CorelDRAW establishes a movable vanishing point (in the form of an x) for each perspective envelope it creates. To create consistent 3-D space, simply align all of the vanishing points to an underlying perspective grid.**

ALIGNING ANIMATION ELEMENTS

❓ I've seen wonderful animations created with Autodesk Animator Pro where dozens of objects move independently and yet end up perfectly aligned. I've been unable to create animations with the same level of precision. Any ideas?

Anthony D'Auria
Bayside, New York

▶PC MAGAZINE: Syncing and aligning animated elements (called cels) is no small feat. This is especially true of a raster program like Animator Pro where you're working with pixels and screen coordinates—rather than a finite measurement system like inches or points. To Autodesk's credit, there are so many techniques available that we don't have room to explore them all here. But here's one technique that can help you keep your animations on track.

If the final position of a cel is the most important aspect of a movement sequence, just begin with the ending. That's right: Determine the cel's final resting place before you do anything else. The Move command (located on both the Cel and Anim Cel menus) allows you to reposition a cel without pasting it down.

Once you've aligned the cel you can use the Optics panel to move it to its starting point. You'll find that you have a lot more latitude with starting positions developed in this way—especially if the starting position is off screen. Before you actually render the sequence, be sure to click the Reverse button in the Time Select panel. When the Reverse option is active, Animator Pro transposes the beginning and ending positions of the cel. The result? A complex movement that ends with perfect placement.

By the way, this technique is especially useful when you're working with a number of different cels. Animator Pro includes positioning information (in the form of *x* and *y* screen coordinates) along with the image information whenever you save a cel to a disk file. So start with a totally composed image. Then clip a series of cels and save each one to disk. The next time you load the cel into Animator's cel buffer to create an animation sequence, it will already be correctly aligned and positioned.—*Luisa Simone*

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❓ In the September 15, 1992, column you described Novell's Burst Mode Protocol. We have a 1,200-node network with Token-Ring segments connected by an FDDI backbone. Using burst mode on DOS PCs, we've experienced reductions

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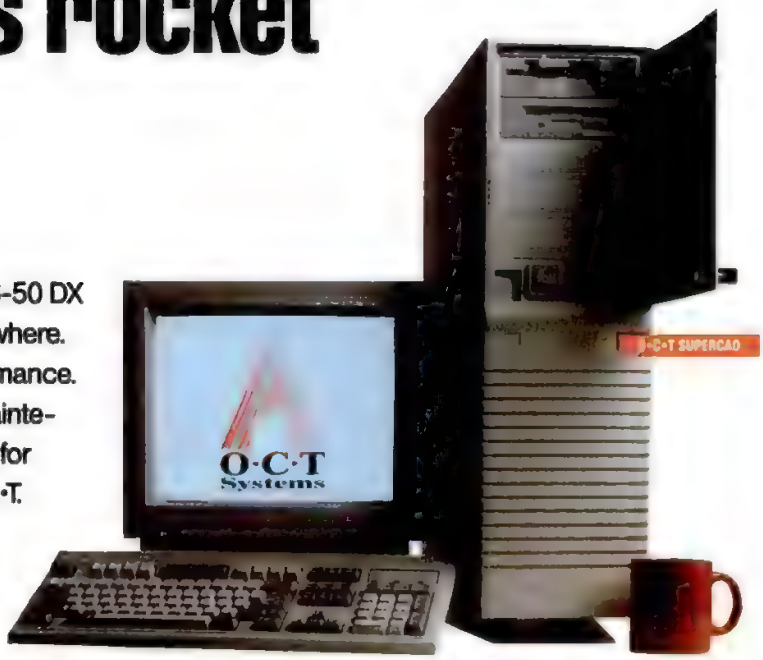

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of 70 percent in the time required to copy files from the servers to a workstation, and programs often load twice as fast. We encounter problems, though, under Windows.

When we try to use Windows with Burst Mode, programs hang and the environment becomes unstable. After discussions with Novell and Microsoft, we believe that the problem occurs because both BNETX.COM and Windows try to control the PC timer interrupt.

It frustrates us that we can't use burst mode with Windows when it improves performance so dramatically under DOS. Can you give us any clues about its future?

Mark Yount
Philadelphia, Pennsylvania

▶**PC MAGAZINE:** Novell acknowledges the problem with burst mode's BNETx and Windows. NetWare 4.0, officially slated for release at the end of 1992, will contain new software to squash the bug. At the same time, the company plans to update its NetWare Workstation Kit for DOS and Windows, which will add burst mode capability to older editions of NetWare.—*Frank J. Derfler*

LINKING SPREADSHEETS

❓ We run NetWare, Version 2.15, over DOS and would like to link our Lotus 1-2-3 spreadsheets across the accounting department. In other words, we want two people on the network to enter data into separate spreadsheets that feed a third. How can we make these links?

James Nelson
Rockford, Illinois

▶**PC MAGAZINE:** You stand on the cutting edge of modern workgroup interaction: sharing data *objects* instead of files and drives. As new applications emerge, this concept of shared data will become increasingly important to anyone who plans for or manages a network.

If you plan to move to Windows, then the networked Dynamic Data Exchange capability of Microsoft's Windows for Workgroups makes it easy to cut and paste segments of spreadsheets and use them interactively. This is an excellent general purpose facility that also allows you to paste spreadsheet data into written documents and other types of presentations.

But if you're really serious about linking spreadsheets over a LAN, you should look at the TM/1 Spreadsheet Connector from Sinper Corp. in New Jersey (908-755-9880). The five-user entry-level version retails for $985. More sophisticated versions cost over $5,000.

The application runs over Novell's IPX or NetBIOS-based network operating systems such as POWERLan and LANtastic. It works simultaneously with Lotus 1-2-3 and Microsoft Excel. With the TM/1 Spreadsheet Connector loaded on a PC, you can slice out part of a spreadsheet, protect certain cells in that piece from change, and link it to slices on other networked PCs. The program creates a live link between the portions and lets users work on the shared spreadsheet interactively. Those who do sophisticated spreadsheet work will appreciate the software's ability to link slices in three dimensions so that specific changes roll into specific spreadsheets in different ways. In a business environment, Sinper's TM/1 provides a lot of flexibility for interactive workgroup processing.
—*Frank J. Derfler, Jr.*

Languages

VARIABLE-ARGUMENT FUNCTIONS

▶**PC MAGAZINE:** Unlike other languages—many of which don't offer a feature for passing variable numbers of arguments to a function—C and C++ offer a simple, portable mechanism for creating variable-argument functions. This mechanism, part of the ANSI C (Standard C) definition, is available through three macros which can be found in STDARG.H (shown in Figures 9 and 10). The macros successfully hide the details of the mechanism, which may differ across platforms—or even compilers. And the macros are easily understood, making programs that use them eminently more readable. You can use these macros to define functions that take a variable number of arguments and walk the argument list to retrieve the arguments.

There are a few restrictions for using this approach. First, Standard C demands that when you define a function with a variable argument list, the list must be preceded by at least one fixed, specified argument. In addition, the macros won't help you if your argument list contains variables of different data types. The macros assume you know what data type each argument is, or have a means of retrieving them. Finally, there's no built-in, foolproof way to know how many arguments are in a variable argument list. You either have to use a format string (as does printf()) to tell you how many arguments should have been passed to the function

C and C++ offer a simple, portable mechanism for creating variable argument functions.

or you must create a standard for terminating the argument list (such as using a 0 or NULL to terminate string arguments and a -1 to terminate an integer argument list).

The standard library function, printf(), is a classic variable argument list function. But printf() can decipher the types and number of arguments passed to it from the format string that's passed as its only fixed argument:

```
int printf(const char
 *format,. . .);
int i = 3;
int l = 100000L;

printf("%d is not %ld!\n",i,l);
```

Each % identifies a variable argument, and the characters following a %—in this case d or ld—identify an argument's data type (here, as either int or a long). So you must design your variable argument functions to either provide such a list of argument types, or assume that all arguments in the variable list are of the same data type.

There are a few other restrictions. You should *not* use data types that widen when passed as an argument to a function. Thus, you should replace references to float with double; and char, unsigned

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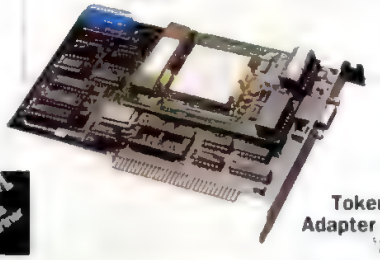

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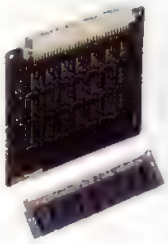

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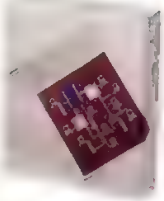

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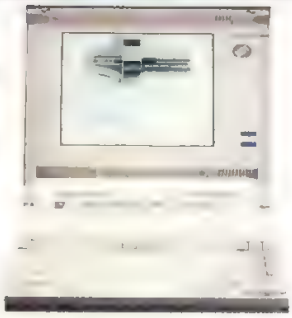

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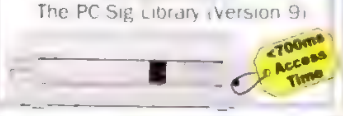

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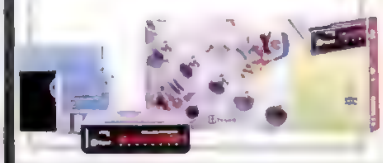

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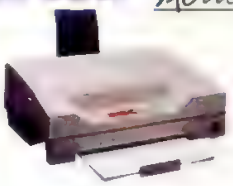

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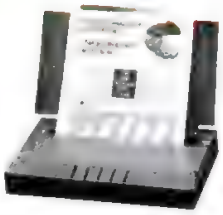

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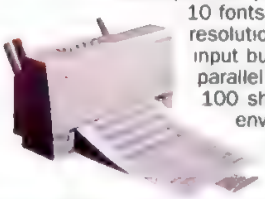

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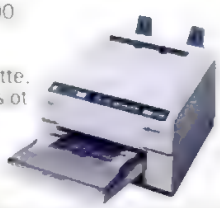

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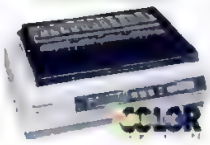

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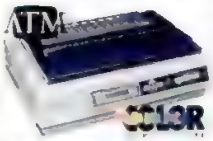

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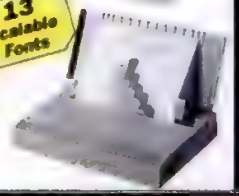

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Code # PN

char, short, and unsigned short with int or unsigned int. And you should use only data types that can be converted to a pointer by appending a *, such as int or char. You can't use int *[10] as a valid data type in the variable argument list.

Using the variable argument list macros is pretty trivial. First, you define a function to use a variable argument list. For example,

```
char *cat(char *dest,...);
```

Here, the cat() function takes a variable number of string arguments and concatenates them into the location pointed to by dest. (On returning, the function returns the address pointed to by dest.) To process the variable argument list, the function must define a variable of type va_list:

```
char *cat(*dest,...)
    {
    va_list argptr;
    char *next;
```

The va_list variable will point to the members of the variable argument list while the function processes the list. Your function must initialize the va_list variable via the va_start macro, using the last fixed argument in the function's argument list as base:

```
va_start(argptr, dest);
```

Here, the va_start macro will set the va_list variable, argptr, to the first argument in the variable list following the last fixed argument. This macro works by taking the address of dest, adding the size of dest to it, and setting argptr to the result.

To access each argument in the list, you use the va_arg macro:

```
while((next = (char*)
va_arg(argptr,char *)) !=NULL)
    strcat(dest,next);
```

Here, va_arg retrieves the next argument from the list into next. As each argument is retrieved, it is concatenated into dest.

The va_arg macro cleverly does two things. First it increments the argptr variable to point to the next argument in the list. To do this, it must know the data type of the current argument which you specify in va_arg's second parameter. Second, va_arg returns the address of the current argument. It does this by subtracting the size of the current argument from the next argument's address—to which argptr has just been assigned. In pseudocode, this would be:

```
// use type in 2nd param to get
   the type's size
// increment argptr by that amount
// return the address in argptr
   minus that amount
```

Thus, each call to va_arg increments argptr to the next argument while it returns the address of the current argument (which argptr was pointing to before va_arg was called).

You can use va_arg as many times as necessary to access arguments in a variable list, but you need to have some way to detect the end of the list. Again, this means establishing a convention of some sort (like those I mentioned earlier).

Finally, you should call va_end when you've finished scanning the list:

```
va_end(argptr);
```

Note that in Borland's implementation of va_end (Figure 10), va_end does nothing, while in Microsoft's (Figure 9), argptr is set to zero. Standard C states that va_end is implementation specific: It ensures that any cleanup that might need to be performed is performed. While there's no critical cleanup required by these implementations of STDARG.H, an advantage of Microsoft's approach is that with argptr set to zero, you'll quickly get an error (such as a NULL pointer access) if you try to reuse argptr without first calling va_start again. With the Borland implementation, there's a chance you could inadvertantly reuse argptr when it's no longer valid and not immediately detect an error.

You can rescan the list at any time—even if you haven't reached its end. The safe way to do this is to call va_end first and then call va_start. You should call va_end for every call to va_start.

To illustrate the power of variable ar-

STDARGS.H, MSC++7.0
Partial Listing

```
typedef char _FARARG_ *va_list;

#define _INTSIZEOF(n)        ((sizeof(n)+sizeof(int)-1) &
~(sizeof(int)-1))

#define va_start(ap,v) ap = (va_list)&v + _INTSIZEOF(y)
#define va_arg(ap,t) (*(t*)((ap += _INTSIZEOF(t)) -
_INTSIZEOF(t))) #define va_end(ap) ap = (va_list)0
```

Figure 9: **This shows Microsoft's implementation of three macros you can use for creating variable argument functions.**

STDARGS.H, BC++3.1
Partial Listing

```
typedef void _FAR *va_list;

#define __size(x) ((sizeof(x)+sizeof(int)-1) & ~(sizeof(int)-1))

#if defined(__cplusplus) && !defined(__STDC__)
#define va_start(ap, parmN) (ap = ...)
#else
#define va_start(ap, parmN) ((void)((ap) = \
    (va_list)((char _FAR*)(&parmN)+__size(parmN))))
#endif

#define va_arg(ap, type) (*(type _FAR *)\
    (((*(char _FAR * _FAR *)&(ap))+=__size(type))-
__size(type))) #define va_end(ap)          ((void)0)
```

These macros from Borland's version of a simple, portable mechanism for creating variable functions.

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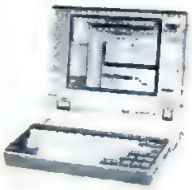

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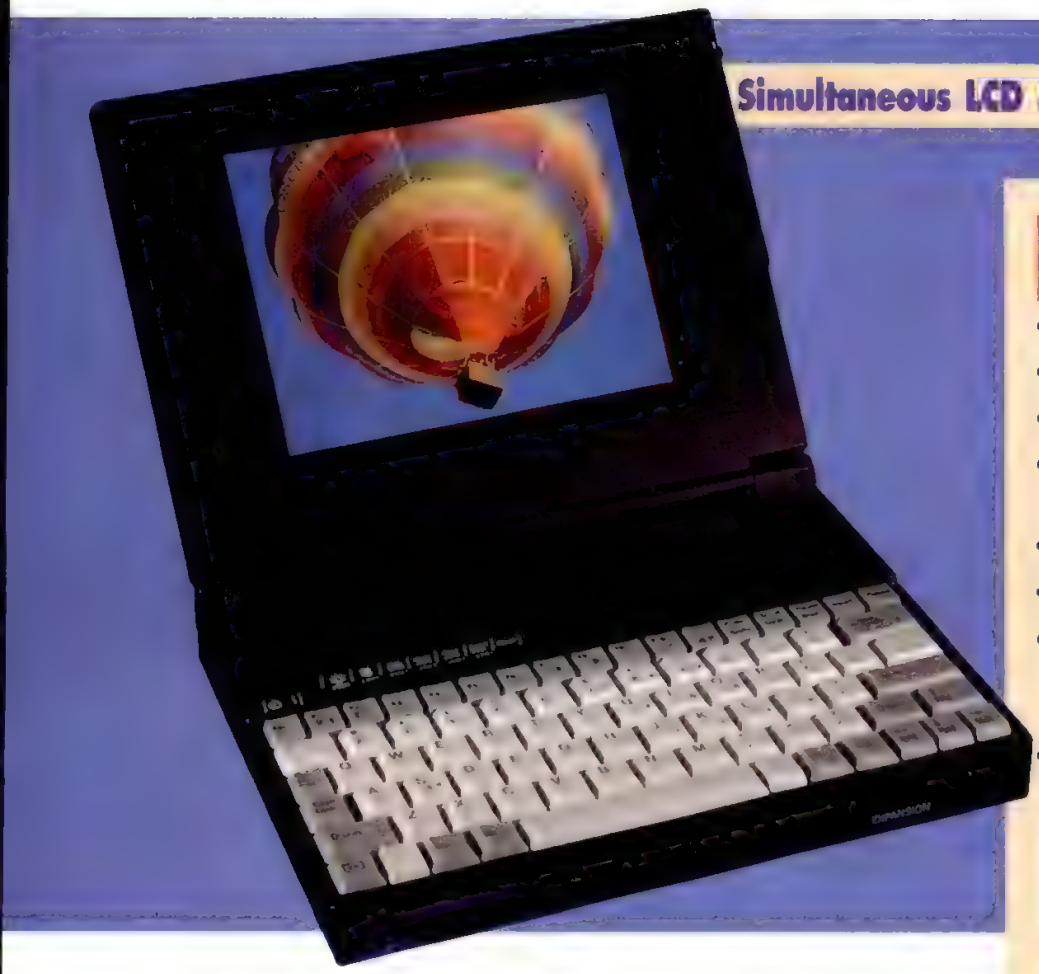

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VARARGS.C

Complete Listing

```
/* varargs.c
 *
 * This program demonstrates the use of variable argument functions.
 *
 */

#include<stdarg.h>
#include<stdio.h>
#include<string.h>

void main(void);
void var_args(char *message,...);
void message(char *message,...);
char *cat(char *dest,...);
int largest(int x,...);
int average(int x,...);

void var_args(char *message,...)
    {
    va_list argptr;
    int value;

    printf("message=%s\n",message);

    va_start(argptr,message);
    while((value = (int)va_arg(argptr,int)) != -1)
        printf("value=%d\n",value);
    va_end(argptr);
    }

void message(char *message,...)
    {
    va_list argptr;

    va_start(argptr,message);
    vprintf(message,argptr);
    va_end(argptr);
    }

char *cat(char *dest,...)
    {
    va_list argptr;
    char *next;

    va_start(argptr,dest);
    while((next = (char *)va_arg(argptr,char *)) != NULL)
        strcat(dest,next);
    va_end(argptr);
    return dest;
    }

int largest(int x,...)
    {
    va_list argptr;
    int largest = x, thisarg;

    va_start(argptr,x);
    while((thisarg = (int)va_arg(argptr,int)) != -1)
        if(thisarg > largest)
            largest = thisarg;
    va_end(argptr);
    return largest;
    }

int average(int x,...)
    {
    va_list argptr;
    int av = x, thisarg, count = 1;

    va_start(argptr,x);
    while((thisarg = (int)va_arg(argptr,int)) != -1)
        {
        av += thisarg;
        count++;
        }
    va_end(argptr);
    return (av ? (av / count) : 0);
    }


char buf[200];
void main(void)
    {
    var_args("The arguments are: 10,9,8 and 7",10,9,8,7,-1);
    message("The arguments are: %d,%d,%d and %d\n",10,9,8,7);
    buf[0] = '\0';
    printf(cat(buf,"This ","is ","a ","test.\n",NULL));
    printf("largest in list is %d\n",largest(10,20,30,40,50,60,70,-1));
    printf("average is %d\n",average(10,20,30,40,50,60,70,-1));
    }
```

Figure 11: **This is the C source code for a program that demonstrates the use of variable argument functions. To compile it as a C++ program, just rename it VARARGS.CPP.**

gument functions, I've written a program, VARARGS.C, shown in Figure 11 (C++ programmers can simply rename it VARARGS.CPP). The program offers five simple variable argument functions. The first, var_args, takes a string parameter and a variable list of integers and prints the value of each integer. The second function, message(), calls the variable argument print function, vprintf(), to process a format string and a variable list of parameters. The cat() function, as discussed above, is included. And two additional functions, largest() and average(), return the largest value and the average value from a list of integers.

Note that the var_args, largest(), and average() functions all take variable lists of integers, which must be terminated with a -1. The cat() function's list is terminated with a NULL. The message() function provides a format string with the number and types of arguments to vprintf(), so it doesn't require a way to terminate the list.

You can compile VARARGS with Borland C++ 3.1 and 3.0 using:

```
BCC varargs.c
```

or

```
BCC varargs
```

to compile the C++ version.

The Microsoft C++ 7.0 compiler uses

```
CL varargs.c
```

for the C version or

```
CL varargs.cpp
```

for the C++ version. You can also download the source code and executable files from PC MagNet archived as VARARC.ZIP.—*Richard Hale Shaw*

On-Line

ZIFFNET/PROCOMM CONFLICT

❓ When I try to log on to ZiffNet to download the latest *PC Magazine* utilities or other files, I can't get past the "Welcome to ZiffNet" screen because Procomm Plus indicates that CompuServe is trying to download something to me, but then everything just locks up. I can't even get on to ask somebody why I can't get on! Can you help?

Michael D. Osborn
St. Louis, Missouri

▶**PC MAGAZINE:** This is a fairly common problem caused by a combination of CompuServe/ZiffNet defaults and Procomm's support for automatic downloads.

CompuServe defaults to sending a *micro enquiry sequence* (commonly abbreviated ENQ); This means that when you first log on to CompuServe, the host system sends a set of characters to your system to determine what communications software it's using.

Since ZiffNet uses the same software and computers as CompuServe, it also sends the ENQ. Unfortunately, the ENQ used when you log on is exactly the same as the ENQ CompuServe uses to initiate an automatic download. Automatic

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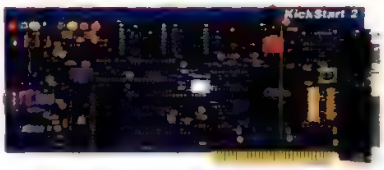

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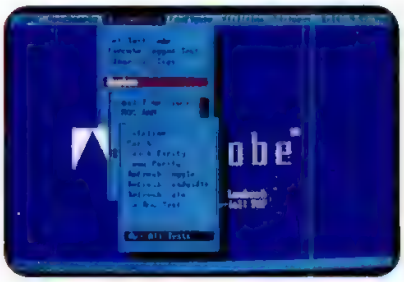

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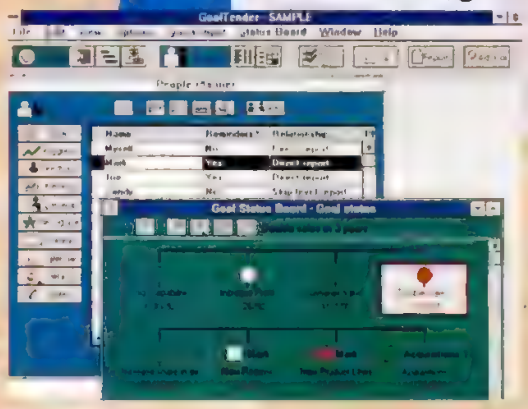

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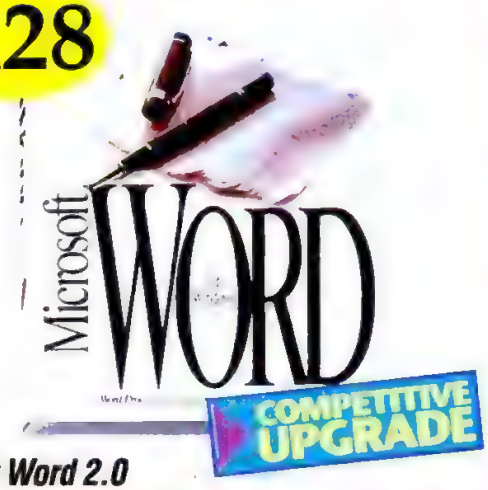

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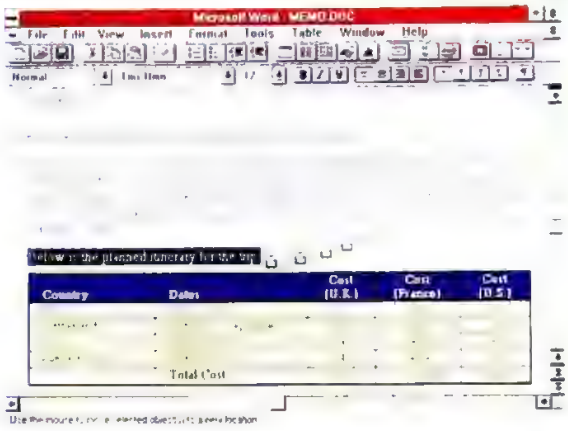

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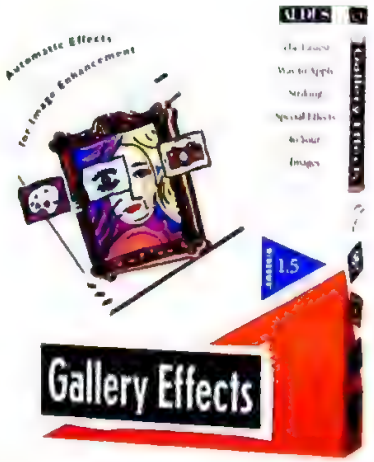

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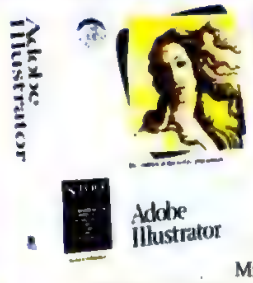

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downloads mean that Procomm (like other communications packages) has the ability to detect that the remote system is starting a file transfer and automatically activate the correct protocol to receive the file. Protocols such as ZModem and CompuServe-B support automatic downloads.

So if your software supports automatic file transfers (as Procomm Plus does) and that's how you've set it up, it can misinterpret the log-on ENQ and think a file is about to be transferred. Fixing this is a three-step process: disable automatic transfers, tell CompuServe not to use the micro enquiry sequence, reenable automatic transfers.

First, turn off the automatic transfer feature in Procomm Plus using its setup options screen. At the main Procomm screen, hit Alt-S to bring up the setup menu; T (Terminal Options); and finally J, the Enquiry option, which you'll set to OFF. When you've finished your work, go back to the main screen and call ZiffNet.

This time, you should be able to log on to CompuServe with no problems. Type GO DEFAULTS to get to the account defaults screen, and choose option 2 (Change permanent settings). On the next menu, select option 4 (Terminal type/parameters) and then change option 11 (Micro enquiry sequence at log-on) to NO. Hit Enter to get back to the previous menu.

The next step assumes that your default protocol is CIS B. If it's not, change it by selecting option 5 (Transfer protocol/graphic support) and then option 1 (Protocol preference). At the next menu, pick the first option (B Protocol), then hit Enter twice to return to the settings menu. Finally, choose option 6 (Make session settings permanent). Note that CompuServe maintains a different set of defaults for each communications speed. If you use different speeds when you call ZiffNet (say, 9,600 bps to download, but 2,400 bps to read messages), you'll have to dial in at each speed and repeat the process.

The next time you dial in, everything should be fine. You'll probably want to restore the automatic downloads at this point, or you won't be able to receive binary transfers through the CompuServe/ZiffNet mail system. Go back into Procomm's setup and change the Enquiry option to CIS B. You can't just set it to ON: This tells Procomm to send a keystroke macro when it receives the ENQ sequence, an option usually used for logging into minicomputers or mainframes. Make sure that you don't forget to save your new settings before you exit the setup menu.

Once you're on-line, you may want to download a set of Procomm Plus scripts called ZiffPlus that make it easier to navigate around ZiffNet and to download files. You can download the scripts from the CIS Navigation Tips Library of the Utilities/Tips Forum on PC MagNet archived as ZIFF.ZIP. Note also that Datastorm Technologies, the vendor of Procomm Plus, is one of the many companies that offers a support forum on CompuServe itself. In order to get there from ZiffNet, just type GO CIS:DATASTORM.—*Joe Salemi* □

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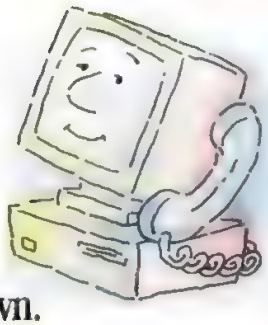

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W MYOB Accounting for Windows 135

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AutoSketch for DOS 149
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Design Cad 3D 4.0 250
Generic Cadd 6.0 289
W Drafix Cad for Windows 2.1 429

COMMUNICATIONS
DOS FaxPro 2.0 49
Intel Satisfaxion 400 Int. 439
Jetfax Pro 4.0 105
PC Anywhere (Host & Remote) 4.5 119
ProComm Plus 2.01 74
Reflection 4 Plus 4.2 299
Telebit QBlazer Modem 9600 299
Worldport 2496 Fax Modem V.42 269
DW Carbon Cpy Plus D/W 135/145
W CC Mail Wind Plat Pack 1.11 359
W Close Up Suppt/Cust Win 4.0 129
W Crosstalk for Windows 1.2 119
W ProComm Plus for Windows 105
W Reflection 2 Windows 239
W Winfax Pro 75

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Foxpro Single User 2.0 519
Funcky Lib 2.0 459
R & R Relational Report Writer 4.0 175

DESKTOP PUBLISHING
MoreFonts 3.01 75
Scanman 256 282
DW By Design for DOS/Wind 59
DW Ultascript PC/PC Plus 3.0 112/245
DW Ventura Publisher DOS/Wind 529
W Adobe Type Manager for Wind 2.0 64
W Bitstream Makeup 95
W Omnipage Professional 2.1 549
W Pagemaker 4.0 499

ENTERTAINMENT EDUCATION
Bodyworks Adventure In Anatomy 45
Design Your Own Railroad 42
Language Assistant—Each 4.1 42
Links 386 Pro 44
Orbits Voyage thru the Solar System 35
PC Globe 5.0 39
Science Adventure 52
The New Print Shop PC w/Holiday Fun 35
DW Chessmaster 3000 DOS/W 32/39
DW Smarty DOS/Windows 32/37
DW Simearth DOS/Windows 42
W MS Entertainment Pack I,II,III—Ea 28
W MS Golf for Windows 49
W Sky for Windows 89

FORMS FLOWCHARTING
Flowcharting III 142
Formtool Gold 3.0 55
Interactive Easyflow 7.0 165
DW Org Plus Adv D/W 6.0 84/129
W ABC Flowchartor 189
W Org Plus Adv for Windows 129
W Per Form Pro Plus 251

GRAPHICS
Dan Bricklin Demo II 199
Harvard Graphics 3.0 419
Hijaak 2.10 125
Pizazz Plus 3.0 85
Presentation Task Force 4.0 134
DW Freelance Upgr DOS/W—Ea 105
DW Freelance Graph D/W 335/349
W Adobe Illustrator Windows 4.0 449
W Corel Draw Windows 3.0 409
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W HiJaak for Windows 1.0 125
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W Stanford Graphics 2.0 369

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W Lotus SmartSuite 489
W MS Office For Windows 3.0 495

LANGUAGES PROGRAMMING
MS Macro Assembler 6.0 105
MS Visual Basic DOS Standard 135
Object Professional for C++ 169
Object Professional Turbo Pascal 1.14 129
Turbo C Tools 99
Turbo Professional 5.12 89
Turbo Vision Developer's Toolkit 103
DW MS C Compiler C/C++ 7.0 319
DW Turbo C++ DOS/Win 72/109
DW Turbo Pascal DOS/Win 99/109
W Borland C++ 3.1 349
W Borland C++ w/Appl Frmwrk 3.1 525
W MS Visual Basic 135
W Smalltalk Windows 309
W Toolbook 1.5 299
W Win ++ 175

MULTIMEDIA/CD ROM
Grolier's New Electronic Encyclopedia 229
Pro 16 Multimedia Syst Int 1035
Pro Audio Spectrum 16 229
Sound Blaster Multimedia Upg Kit Int 589
Sound Blaster Speakers 39
Sound Blaster Pro Basic 165
Sound Blaster Professional 199
W Autodesk Multimedia Explorer 125
W MS Multimedia Bookshelf for Win 135

NETWORKING
Etherlink III 149
Fantastic Ethernet Adapter AE2 4.1 215
NE 2000 16-bit w/o Cable 189
SMC Ethercard Plus Elite (16 Bit) 149
Wordperfect Office DOS Single 3.1 95
Xircom PE210B2 New Tractor 319

OPERATING ENVIRONMENTS
Desqview 386 2.4 139
Desqview/X 175
IBM OS/2 2.0 142
IBM OS/2 Upgrade 109
MS DOS 5.0 74
MS DOS Upgrade 5.0 85
W MS Windows 3.1 92
W MS Windows Upgrade 3.1 49
W HP New Wave 4.1 109
W MS Win 3.1 & DOS 5.0 Upgr 146

PERSONAL INFORMATION
Automap Europe 79
Dr. Schueler's Home Medical Advisor 49
Infoselect 2.0 99
Lotus Organizer 2.0 105
Smart Investor 54
DW Automap DOS/Windows—Each 54
W Packrat 4.1 245

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Project Scheduler V 1.5 459
W MS Project for Windows 3.0 455

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Lotus 1-2-3 2.4 339
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DW Quattro Pro DOS/Wind 4.0 309
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Grapher 145
Mathcad 2.5 325
Mathematica 386 w/387 Supp 2.1 749
SPSS PC Base Module 4.0 199
SPSS PC Plus Adv Stats 4.0 300
Sigma Plot 5.0 455
Statgraphics 5.1 709
Surfer 358
DW System 5.0 738
W Mathcad for Wind 3.1 325
W Mathematica for Windows 2.1 935

UTILITIES
386 Max 6.01 84
Automenu 4.7 39
Check It Plus 85
Checklist DOS 59
Disk Manager (DOS) 5.1 39
Dr. Solomon's Anti Virus Toolbox 67
B-Vira Antivirus 29
Norton Desktop for DOS 1.0 95
Norton Utilities 6.01 115
PC Kwik Powerpak 2.1 84
PC Tools Deluxe 6.0 135
PKZip/PKUnzip 49
Power Menu Plus 6.0 61
Pratcache 3.0 95
Q DOS 3 45
QEMM 386 6.02 62
Spinrite II 2.0 58
Stacker 2.0 95
Superstor Pro 89
System Sleuth Pro 4.0 99
XTree Gold 2.5 99
Xtradrive Data Compression 64
DW Fastback Plus D/W 119/122
DW Norton Antivirus for D/W 2.1 89
DW Norton Backup for D/W 2.0 89/99
W Afterdark for Windows 2.0 30
W Norton Desktop for Wind 2.0 119
W Winsleuth Gold 99
W XTree for Windows 39

WORD PROCESSING
Screen Extender Wordperfect 2.0 59
Wordperfect 5.1 272
DW Grammatik 5 DOS/Wind—Ea 58
W AmPro Competitive Upgrade 3.0 105
W MS Word for Windows Upgr 2.0 127
W Wordperfect 5.1 to Windows Upgr 85

HARDWARE
Canon Bubblejet BJ 10ex (black) 307
Canon Bubblejet BJ 20 (black) 419
Canon Bubblejet BJ 300 465
Canon Bubblejet BJ-800 (Colmics) 2015
Colorado DJ 20 278
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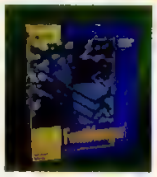

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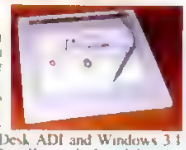

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Microsoft
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- Serial with Windows 147
- Ballpoint 119

NETWORKING

Artisoft/Lantastic
- Lantastic for Windows 165
- Lantastic 2 Station Ethernet Kit 469
- Ethernet Additional Stations 209

Eagle
- NE2000 2 Station NW Lite Kit 419
- NE1500 16 Bit 10baseT Adapter 149

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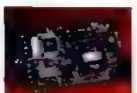

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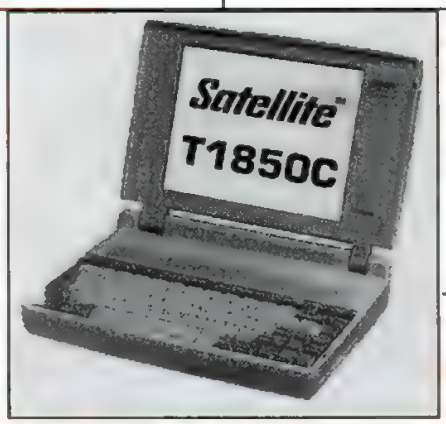

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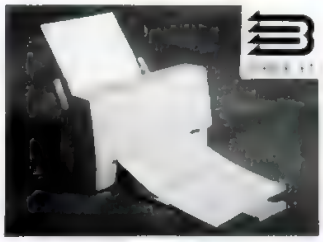

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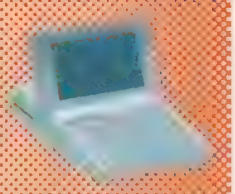

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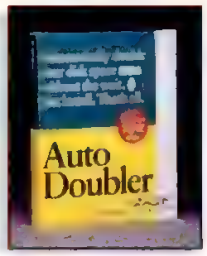

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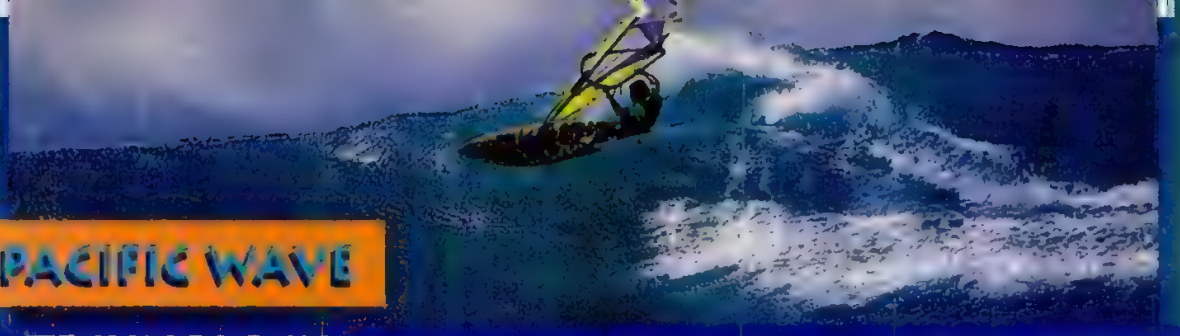

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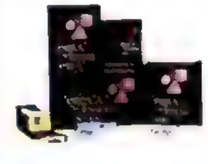

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Desqview 386 2.4 127
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Disk Optimizer
DOSFax Pro
DR DOS 6.0 / Netware Lite 1.1 67
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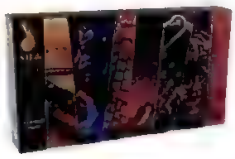

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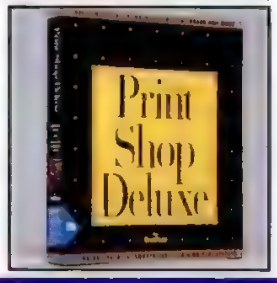

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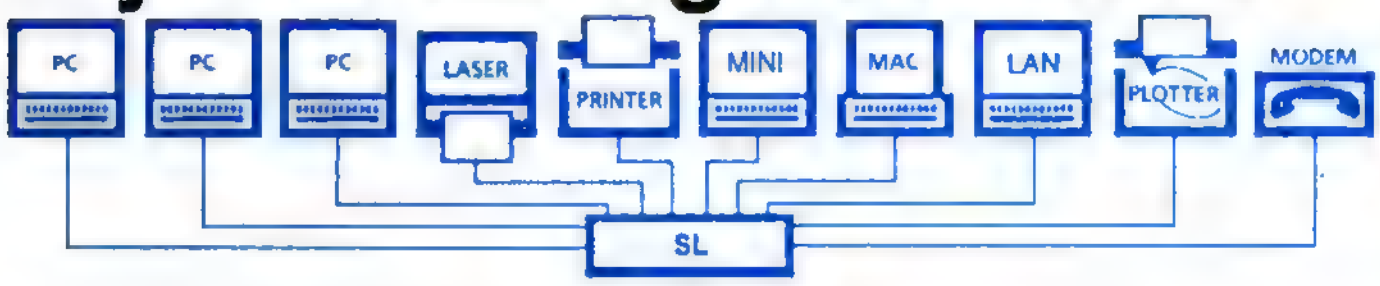

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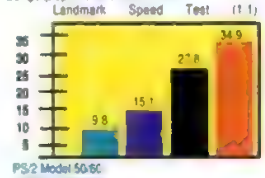

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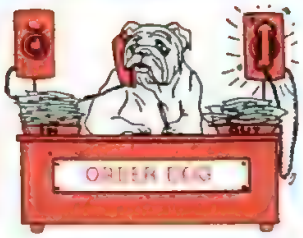

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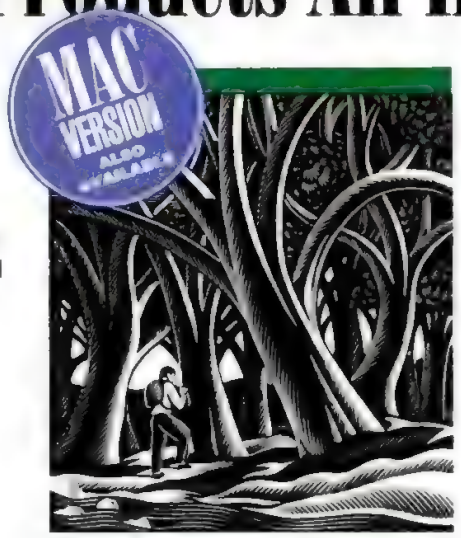

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Communications		509	
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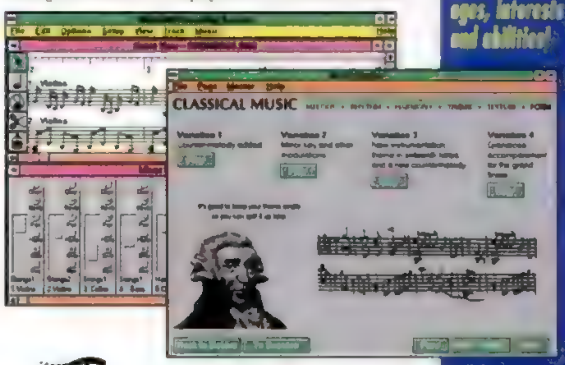

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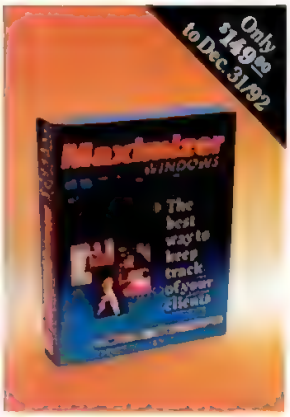

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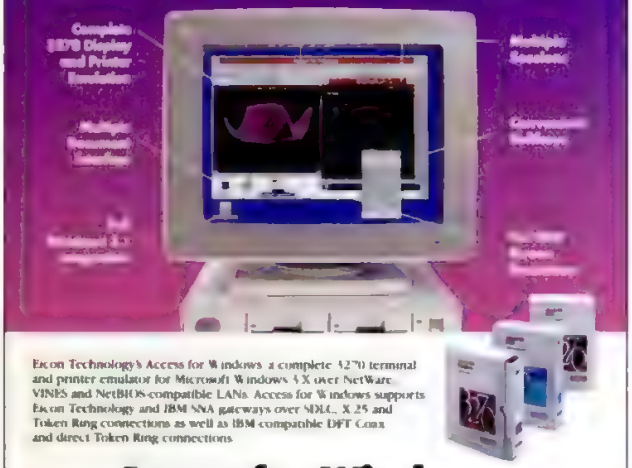

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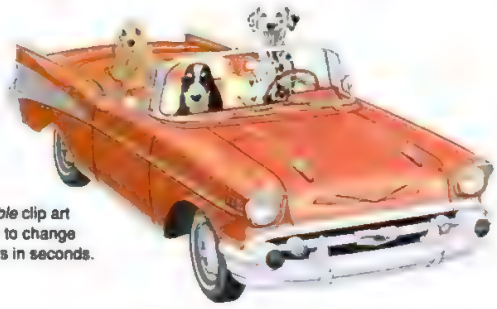

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03. ☐ Manufacturer—Other
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5. For how many IBM PCs and compatibles do you specify brands of products:
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02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office? (Check all that apply.)
01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)
01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC Products?
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02. ☐ In 4 to 6 months
03. ☐ In 7 to 12 months
04. ☐ No definite plans

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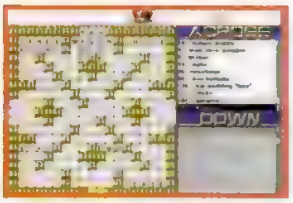

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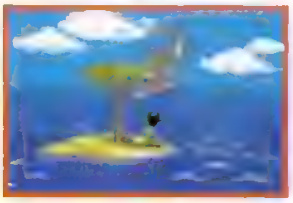

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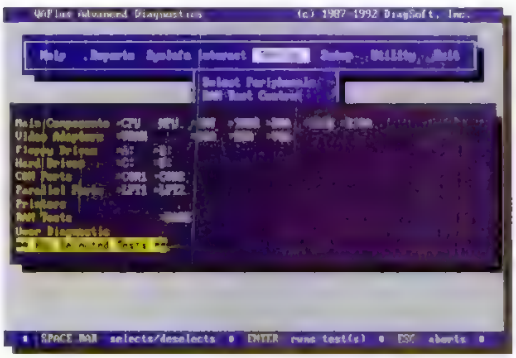

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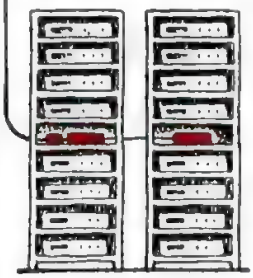

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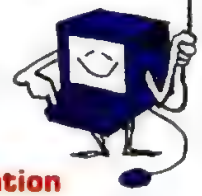

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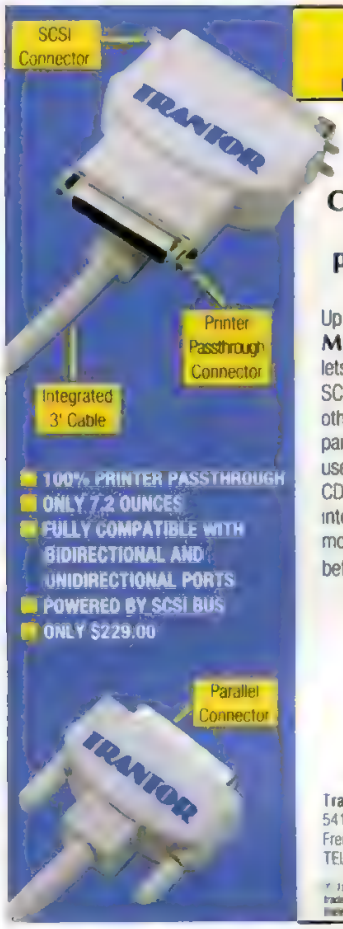

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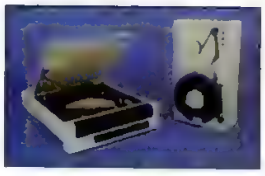

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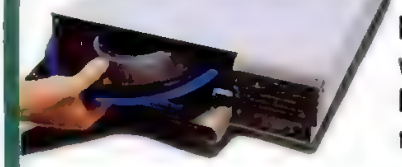

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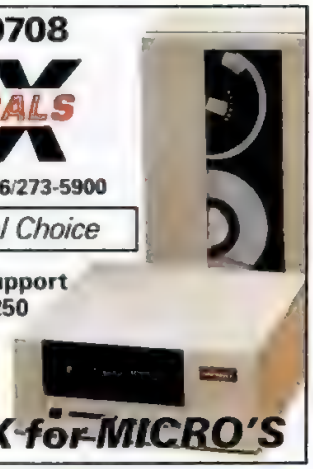

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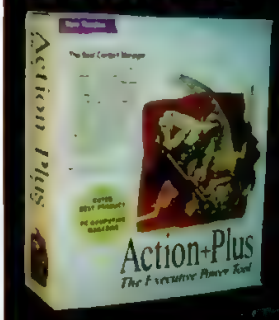

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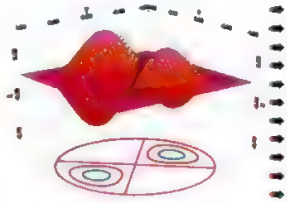

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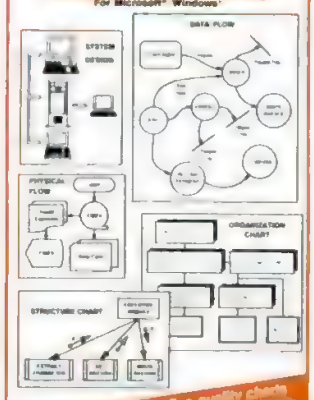

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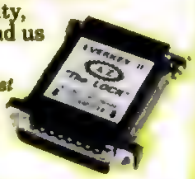

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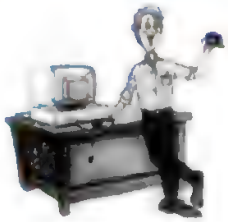

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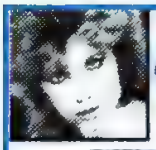

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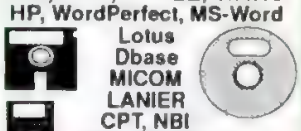

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Advertisers' Index
COMPANIES

Reader Service No.	Advertiser	Page
167	3M Data Storage Products	326-327
123	Accolade	533
034	Acer America	84
360	Acma Computers	413
096	AddStor	329
368	Adobe Systems Inc	96
112	Agatech	444-445
194	Amax Engineering	149
162	American Power Conversion	98
*	Apple Computers	137-140
027	Appoint, Inc	265
209	Ariel Design Inc	410
336	Arlington Computer Products	480
254	Artisoft Inc	251
008	ASP Computer Products	86
337	ATI Technologies Inc	245
099	Aurum Computers	249
012	Austin Computer Systems	13-15
129	Avery Dennison	159
351	Banner Blue Software	261
285	Borland International	52-53
287	Borland International	56-57
220	Borland International	60-61
295	Borland International	64-65
328	Buffalo Products	492
015	Bulldog Computer Products	495
388	CallSoft	367
190	CallSoft	369
079	Central Point Software	41
*	Chipsoft Inc	227
178	Claris Corporation	106-107
026	Colorado Memory Systems	36
144	Comp USA	472
308	Compaq Computer	150-151
137	Compaq Computer	257
128	CompuAdd Express	211-214
126	CompuAdd	183-188
205	Compuclassics	473
132	CompuDyne	165-167
357	CompuDyne	314-315
300	Computability	464-465
348	Computer Associates	2-3
400	Computer Associates	5
109	Computer Discount Warehouse	476-479
177	Computer Express	488
158	Computer Library	496
105	Computer Peripherals Inc	4
*	Comtrade	439
011	Corel Corporation	68
086	Creative Labs	292
171	DataSouth Computer Corp	263
389	DCA	6
*	Dell Computer Corporation	C5-C8
*	Dell Computer Corporation	202-203
*	Dell Computer Corporation	306-307
*	Dell Computer Corporation	339
250	Delrina Technology	43
188	Digicom Systems, Inc	226
049	Digital Equipment Corp	231-236
*	Dow Jones Information Svcs	259
140	DTK Computer	143
243	Dustin America	47
180	Dustin America	80
168	Dustin America	398
347	Dustin America	406-407
119	Edge Technology	416-417
*	EPS Technology	433-436
305	Expo Tech	440-441
*	FASTMICRO	419-424
352	FASTMICRO	474-475
382/320	First Source International	494
*	Gateway 2000	48a-h
391	H.Co Memory Upgrades	493
*	Hard Drives International	404-405
*	Hewlett Packard Peripheral Group	134-135
*	Hewlett Packard Peripheral Group	165
102	Hunter Computer	490
*	Hyundai Electronics	295-302
275	Hyundai Electronics	426-427
138	IBM Corporation	18
066	IBM Corporation	66-67
024	IBM Corporation	130-131
075	IBM Corporation	382-383
048	IBM Corporation	395
044	Icom Simulations	224
344	Icom Simulations	225
*	Insight Computers	400-403
363	Intel Corporation	10-11
306	Intel Corporation	354-355
274	Interlink Electronics	463
139	KAO Information Systems	311
106	Kingston Technology	87
019	L.A. Trade	486
169	Landmark	467
237	Lasermaster	379
081	Lexmark International	88-89
182	Logitech	82-83
*	Lotus Development Corporation	81
*	Lotus Development Corporation	94-95
*	Lotus Development Corporation	127
143	Lotus Development Corporation	129
*	Lotus Development Corporation	156-157
263	Macola, Inc	219
365	Manugistics (formerly STSC)	313
050	Mathsoft Inc	291
361	Micrografx	331
*	Microsoft	20-21
*	Microsoft	C2-C4,p1
*	Microsoft	220-221
013	Microtac Software	125
225	MicroWarehouse	192-197
010	Midwest Computer Works	484
283	Nanao Corporation	241
217	NEC Technologies	26-27
394	NEC Technologies	72-73
046	NEC Technologies	99-101
153	NEC Technologies	360
375	NEC Technologies	363-364
*	Northgate Computer Systems	242-243
*	Northgate Computer Systems	350-351
*	Novell Inc	16-17
281	Number Nine Computer Corporation	74
*	Occidental, Inc	33-35
056	Okidata	147
235	Okidata	239
215	Olympic Computer Systems	443
216	P.C. Innovation Computers	442
*	Pacific Data Products, Inc	289
145	Pacific Wave Technology	485
301	Patton & Patton	218
*	PC Brand	173-176
*	PC Connection	282-287
080	Pc Power & Cooling	23
199	PC Zones	468-471
092	PCs Compleat	460-461
324	Peripheral Express	489
219	Practical Peripherals	370
148	Primavera Systems	45
314	Publishing Perfection	491
141	QMS	357
084	Quantum	102
*	Quill Corporation	458-459
*	Scitor Corporation	145
161	Sharp Electronics Corp	247
213	Sigma Data	229
212	SoftMaker	252-255
373	Software Add-Ons	486
302	Software House	78
282	Software Spectrum	133
203	Software Spectrum	309
071	Sony Computer Peripheral	160-161
061	Stac Electronics	70-71
057/059	StatSoft	305
221	Strategic Mapping, Inc	92
365	STSC	313
104	Swan Technologies Inc	341-342
186	Symantec Corporation	28
350	Symantec Corporation	228
265	Symantec Corporation	344
147	Systat Inc	262
289	Tandy Direct	429
045	Tangent Computer, Inc	457
206	TELEMART	481-483
304	Texas Instruments	104-105
353	Texas Instruments	280
379	Toshiba America	76-77
088	Traveling Software	169
121	Tri-Star Computers	414
230	United Education Centers	391
*	US Systems & Technologies	260
*	US Systems & Technologies	374
*	US Systems & Technologies	397
322	US Systems & Technologies	430-431
149	USA Flex	447
189	USA Flex	448-449
210	USA Flex	450-451
160	USA Flex	452-453
163	USA Flex	454-455
204	Vortex Computers	462
309	Windows Sources	396
211	Xircom	152
*	Zenith Data Systems	271-278
063	Zeos Int'l	24-25
125	Zeos Int'l	90
151	Zeos Int'l	113-120
035/115	Zeos Int'l	121
038	Zeos Int'l	266
152	Zeos Int'l	319-324
354	Ziff-Davis Press	437

* No Reader Service #. Please Call Advertiser For Information.

Advertisers' Index
PRODUCTS

Reader Service No.	Company	Product	Page
	ACCOUNTING SOFTWARE		
348	Computer Associates	Windows Family	2-3
400	Computer Associates	AccPac Plus	5
243	Dustin America	DacEasy Accounting	47
263	Macola, Inc	Accounting Software	219
373	Software Add-Ons	Software, Mail Order	486
	ADD-ON BOARDS		
194	Amax Engineering	Amax MotherBoards	148
088	Creative Labs	Sound Blaster	292
382/320	First Source International	Memory, Mail Order	494
237	Lasermaster	Win Print Products	379
	ANTI-VIRUS SOFTWARE		
265	Symantec Corporation	Norton Anti Virus	344
	APPLE PRODUCTS		
*	Apple Computers	MACs	137-140
	BACKUP SOFTWARE		
078	Central Point Software	Central Point Back Up	41
	BOOKS		
354	Ziff Davis Press	Books	437
	CD-ROM		
158	Computer Library	Computer Select	496
168	Dustin America	CD-ROM Products	398
153	NEC Technologies	CD-ROM	360
375	NEC Technologies	CD-ROM	363-364
324	Peripheral Express	Hardware/Peripherals	488
314	Publishing Perfection	Hardware,Software,Peripherals	491
071	Sony Computer Peripheral	CD-ROM	160-161
	CHIPS/PROCESSORS		
382/320	First Source International	Memory, Mail Order	494
363	Intel Corporation	486 Micro Processor	10-11
306	Intel Corporation	Overdrive Processors	354-534
	CO-PROCESSORS		
213	Sigma Data	Math Co-Processors	229
	COMMUNICATIONS SOFTWARE		
109	Computer Discount Warehouse	Peripherals	476-479
263	Macola, Inc.	Accounting Software	219
088	Traveling Software	LapLink Pro	168
	COMPUTERS/COMPATIBLES		
034	Acer America	Acros 325SE	84
380	Acma Computers	Acma PC's	413
112	Agatech	Agatech PC's	444-445
209	Ariel Design Inc.	Computers	410
099	Auburn Computers	Notebook Computers	248
012	Austin Computer Systems	Austin Desktops	13-15
015	Bulldog Computer Products	Compatibles	495
308	Compaq Computer	Systems	150-151
137	Compaq Computer	Compaq Product Micro-Age	257
126	CompuAdd	CompuAdd Systems	183-188
128	CompuAdd Express	CompuAdd Express Systems	211-214
132	CompuDyne	Compudyne Desktops	165-167
109	Computer Discount Warehouse	Networking	476-479
*	Comtrade	Systems	439
*	Dell Computer Corporation	Dell Systems	C5-C8
*	Dell Computer Corporation	Dell Systems	306-307
*	Dell Computer Corporation	Dell Systems	339
049	Digital Equipment Corp	333SX, 433DX, 425SX	231-236
140	DTK Computer	Systems	143
119	Edge Technology	Edge Technology PC's	416-417
*	EPS Technology	PC's	433-436
305	Expo Tech	PC's	440-441
*	FASTMICRO	Systems	419-424
*	Gateway 2000	PC's	48a-h
*	Hard Drives International	PC's	404-405
102	Hunter Computer	Hardware, Software, Reseller	490
*	Hyundai Electronics	386's, 486's	296-302
275	Hyundai Electronics	386	426-427
*	Insight Computers	PC's	400-403
010	Midwest Computer Works	PC's	484
046	NEC Technologies	Select Solutions	99-101
*	Northgate Computer Systems	PC's	242-243
*	Northgate Computer Systems	PC's	350-351
039	Occidental, Inc.	486SX-25, DX-33	33-35
039	Occidental, Inc.	486DX2-50, DX2-66	33-35
*	Occidental, Inc.	Occidental Systems	33-35
219	Olympic Computer Systems	O C T Systems	443
216	P C. Innovation Computers	486 Desktops	442
145	Pacific Wave Technology	Mail Order, Hardware, Software	485
*	PC Brand	Mail Order, PC's	173-176
198	PC Zones	Mail Order	468-471
092	PCs Compleat	Computers	460-461
*	Quill Corporation	PC's	458-459
104	Swan Technologies Inc.	PC's, Mail Order	341-342
045	Tangent Computer, Inc.	Systems	457
121	Tri-Star Computers	Systems, Mail Order	414
*	US Systems & Technologies	Notebooks	260
*	US Systems & Technologies	Notebooks	374
*	US Systems & Technologies	Notebooks	397
322	US Systems & Technologies	Notebooks	430-431
148	USA Flex	Mail Order	447
188	USA Flex	USA Flex Systems	448-449
216	USA Flex	Compatibles	450-451
*	Zenith Data Systems	PC's	271-278
063	Zeos Int'l	Zeos 486 EISA	24-25
125	Zeos Int'l	Zeos Pocket PC	90
151	Zeos Int'l	Zeos Upgradables	113-120
035/115	Zeos Int'l	Z-Card / Z-Quote	121
038	Zeos Int'l	Zeos Color Notebook	256
152	Zeos Int'l	Zeos Freestyle/SL	319-324
	DATA BASE MANAGERS		
285	Borland International	dBase 1.5	52-53
229	Borland International	Paradox 4	60-61
178	Claris Corporation	Filemaker Pro / Windows	106-107
221	Strategic Mapping, Inc	Mapping Software	92
	DATA COMPRESSION SOFTWARE		
096	AddStor	Super Stor	329
061	Stac Electronics	Stacker	70-71
	DESK TOP ORGANIZERS		
044	Icom Simulations	Windows File Manager	224
344	Icom Simulations	Windows File Manager	225
	DESK TOP PUBLISHING		
314	Publishing Perfection	Hardware,Software,Peripherals	491

Reader Service No.	Company	Product	Page
	DISK BACKUP & TAPE DRIVES		
167	3M Data Storage Products	Data Storage Products	326-327
026	Colorado Memory Systems	Jumbo 120 & 250	36
	DISKETTES		
167	3M Data Storage Products	Data Storage Products	326-327
139	KAO Information Systems	KAO Diskettes	311
	DISPLAYS/MONITORS/TERMINALS		
010	Midwest Computer Works	Monitors	484
283	Nanao Corporation	Monitors	241
217	NEC Technologies	Monitors	26-27
046	NEC Technologies	Select Solutions	99-101
104	Swan Technologies Inc.	PC's, Mail Order	341-342
160	USA Flex	Peripherals	452-453
	ELECTRONIC MAIL		
203	Software Spectrum	WordPerfect Office	309
	EMULATORS/PROTOCOL CONVERTERS		
048	IBM Corporation	3270 Emulator	395
	ENTERTAINMENT SOFTWARE		
123	Accolade	Jack Nicklaus/ Hard Ball 3	533
	FLOWCHARTING		
301	Patton & Patton	Flow Charting 3	218
	FONT SOFTWARE		
212	SoftMaker	Font Software	252-255
	FOREIGN SOFTWARE		
013	Microtac Software	Foreign Language Software	129
	FORM DESIGNERS		
250	Delrina Technology	Perform Pro Plus	43
	GENEALOGY SOFTWARE		
351	Banner Blue Software	Family Treemaker	281
	GRAPHICS SOFTWARE		
368	Adobe Systems Inc	Illustrator	98
011	Corel Corporation	Corel Draw 3.0	88
344	Icom Simulations	Graphics Software	225
044	Icom Simulations	Graphics Software	244
*	Lotus Development Corporation	Freelance Graphics for Windows	156-157
361	Micrografx	Designer Software	331
221	Strategic Mapping, Inc.	Mapping Software	92
	HAND-HELD PC'S		
161	Sharp Electronics Corp	Wizard	247
125	Zeos Int'l	Zeos Pocket PC	90
	HARD DISKS		
*	Hard Drives International	Hard Drives	404-405
084	Quantum	Hard Drives	102
	HARDWARE		
194	Amax Engineering	Amax MotherBoards	148
352	FASTMICRO	Hardware	474-475
075	Hard Drives International	Hard Drives, PC's	404-405
075	IBM Corporation	PS Valuepoint Direct	382-383
*	Insight Computers	Hardware	400-403
056	Okidata	LED Printer	147
236	Okidata	Dot Matrix	239
145	Pacific Wave Technology	Hardware	485
084	Quantum	Hard Drives	102
	HIGH RESOLUTION PRINTER BOARDS		
237	Lasermaster	Win Print Products	379
	IMAGE EDITING SOFTWARE		
044	Icom Simulations	Screen Saver	224
344	Icom Simulations	Screen Saver	225
	INPUT DEVICES		
027	Appoint, Inc.	Mouse Tools	265
274	Interlink Electronics	Ports Point	463
182	Logitech	Mouseman	82-83
	INTEGRATED SOFTWARE		
*	Lotus Development Corporation	Lotus Works	81
282	Software Spectrum	Microsoft Office for Windows	133
	LAN ADAPTER BOARDS		
389	DCA	Irmatrac	6
	LANGUAGES		
295	Borland International	BC++3	64-65
348	Computer Associates	Windows Family	2-3
	LOCAL AREA NETWORKING		
254	Artsoft Inc.	LANTastic	251
008	ASP Computer Products	Server Jet	86
015	Bulldog Computer Products	Networking	495
308	Compaq Computer	Systems	150-151
389	DCA	Irmatrac	6
*	Microsoft	Windows for Workgroups	220-221
*	Northgate Computer Systems	Networking	242-243
*	Northgate Computer Systems	Networking	350-351
*	Novell Inc	Networking	16-17
324	Peripheral Express	Hardware/Peripherals	488
045	Tangent Computer, Inc.	LANs	457
216	USA Flex	Network Supplies	450-451
211	Xircom	LAN	152
*	Zenith Data Systems	Notebooks, PC's	271-278
	MAIL ORDER		
380	Acma Computers	Acma PC's	413
112	Agatech	Agatech PC's	444-445
209	Ariel Design Inc.	Computers, Mail Order	410
336	Arlington Computer Products	Mail Order	480
012	Austin Computer Systems	Austin Desktops, Notebooks	13-15
328	Buffalo Products	Printer Sharing	492
015	Bulldog Computer Products	Mail Order	495
190	CellSoft	Mail Order	269
126	CompuAdd	CompuAdd Systems	183-188
128	CompuAdd Express	CompuAdd Express Systems	211-214
205	Compuclassics	Mail Order Products	473
132	CompuDyne	Compudyne Desktops	165-167
357	CompuDyne	Compudyne Notebooks	314-315
300	Computability	Mail Order	464-465
109	Computer Discount Warehouse	Mail Order	476-479

Advertisers' Index
PRODUCTS

Reader Service No.	Company	Product	Page
177	Computer Express	Mail Order	468
*	Comtrade	Mail Order	439
*	Dell Computer Corporation	Dell Systems	CS-C8
*	Dell Computer Corporation	Dell Systems	202-203
*	Dell Computer Corporation	Dell Systems	306-307
*	Dell Computer Corporation	Dell Systems	339
168	Dustin America	CD-ROM Products	396
347	Dustin America	Mail Order Products	406-407
119	Edge Technology	Edge Technology PC's	416-417
*	EPS Technology	Mail Order	433-436
305	Expo Tech	Mail Order	440-441
*	FASTMICRO	Mail Order	419-424
352	FASTMICRO	Mail Order	474-475
382/320	First Source International	Memory, Mail Order	494
*	Gateway 2000	Mail Order	48a-h
381	H.Co Memory Upgrades	Memory, Mail Order	493
*	Hard Drives International	PC's, Hard Drives, Mail Order	404-405
102	Hunter Computer	Hardware, Software, Reseller	490
*	Hyundai Electronics	386's, 486's	295-302
275	Hyundai Electronics	386	426-427
075	IBM Corporation	PS Valuepoint Direct	382-383
*	Insight Computers	PC's, Hardware, Software	400-403
019	L.A. Trade	Mail Order	486
169	Landmark	PC Diagnostics	467
225	MicroWarehouse	Mail Order	192-197
010	Midwest Computer Works	Mail Order	484
048	NEC Technologies	Select Solutions	99-101
*	Northgate Computer Systems	Mail Order	242-243
*	Northgate Computer Systems	Mail Order	350-351
038	Occidental, Inc.	486DX2-50, DX2-66	33-35
039	Occidental, Inc.	486SX-25, DX-33	33-35
*	Occidental, Inc.	Occidental Systems	33-35
215	Olympic Computer Systems	O.C.T. Systems	443
216	P.C. Innovation Computers	486 Desktops	442
145	Pacific Wave Technology	Mail Order	465
*	PC Brand	Mail Order, PC's	173-176
*	PC Connection	Mail Order	282-287
199	PC Zones	Mail Order	468-471
092	PCs Compleat	Mail Order	460-461
324	Peripheral Express	Hardware/Peripherals	489
314	Publishing Perfection	Hardware,Software,Peripherals	491
*	Quill Corporation	Mail Order	458-459
373	Software Add-Ons	Mail Order	466
104	Swan Technologies Inc.	PC's, Mail Order	341-342
045	Tangent Computer, Inc.	Mail Order	457-057
206	TELEMART	Mail Order	481-483
121	Tri-Star Computers	Systems, Mail Order	414
*	US Systems & Technologies	Notebooks	260
*	US Systems & Technologies	Notebooks	374
*	US Systems & Technologies	Notebooks	397
322	US Systems & Technologies	Notebooks	430-431
149	USA Flex	Mail Order	447
189	USA Flex	USA Flex Systems	448-449
210	USA Flex	Compatibles	450-451
160	USA Flex	Peripherals	452-453
163	USA Flex	Printers	454-455
204	Vortex Computers	Laptops, Mail Order	462
*	Zenith Data Systems	Notebooks, PC's, Mail Order	271-278
053	Zeos Int'l	Zeos 486 EISA	24-25
125	Zeos Int'l	Zeos Pocket PC	90
151	Zeos Int'l	Zeos Upgradables	113-120
035/115	Zeos Int'l	Z-Card / Z-Quote	121
038	Zeos Int'l	Zeos Color Notebook	268
152	Zeos Int'l	Zeos Freestyle/SL	319-324

MAINTENANCE

137	Compaq Computer	Compaq Product Micro-Age	257
169	Landmark	PC Diagnostics	467

MAPPING SOFTWARE

221	Strategic Mapping, Inc.	Mapping Software	92

MASS STORAGE

084	Quantum	Hard Drives	102

MEMORY

382/320	First Source International	Memory, Mail Order	494
381	H.Co Memory Upgrades	Memory	493
106	Kingston Technology	Memory	87
019	L.A. Trade	Memory	487
213	Sigma Data	Memory	229

MISCELLANEOUS

274	Interlink Electronics	Porta Point	463
309	Windows Sources	Windows Sources	396

MODEMS

105	Computer Peripherals Inc.	14.4 Fax Modem	4
186	Digicom Systems, Inc.	Scout Plus	226
382/320	First Source International	Memory, Mail Order	494
219	Practical Peripherals	Modem	370
160	USA Flex	Peripherals	452-453

MULTI-MEDIA

380	CellSoft	Microsoft Multimedia	367
086	Creative Labs	Sound Blaster	292

ON LINE DATABASE

*	Dow Jones Information Svcs.	News/Retrieval	258

OPERATING SYSTEMS/ENVIRONMENTS

302	Software House	Windows for Workgroups	79

OPTICAL PERIPHERALS

199	PC Zones	Mail Order	468-471

OS/2 SOFTWARE

138	IBM Corporation	CSet/2	18

PC DIRECT

360	Acma Computers	Acma PC's	413
112	Agatech	Agatech PC's	444-445
208	Anal Design Inc.	Computers, Mail Order	410
336	Arlington Computer Products	Mail Order	480
328	Buffalo Products	Printer Sharing	492
015	Bulldog Computer Products	Mail Order	465
205	Compuclassics	Mail Order Products	473
300	Computability	Mail Order	464-465
109	Computer Discount Warehouse	Mail Order	476-479
177	Computer Express	Mail Order, Software	468
*	Comtrade	Systems, Mail Order	439
168	Dustin America	CD-ROM Products	396
347	Dustin America	Mail Order Products	406-407
119	Edge Technology	Edge Technology PC's	416-417
*	EPS Technology	Notebooks, PC's, Mail Order	433-436

Reader Service No.	Company	Product	Page
305	Expo Tech	Mail Order	440-441
*	FASTMICRO	Mail Order Systems	419-424
352	FASTMICRO	Mail Order	474-475
382/320	First Source International	Memory, Mail Order	494
381	H.Co Memory Upgrades	Memory, Mail Order	493
*	Hard Drives International	PC's, Hard Drives, Mail Order	404-405
102	Hunter Computer	Hardware, Software, Reseller	490
*	Hyundai Electronics	386's, 486's	295-302
275	Hyundai Electronics	386	426-427
*	Insight Computers	Mail Order, Hardware, Software	400-403
*	Insight Computers	Mail Order, Hardware, Software	403
019	L.A. Trade	Mail Order, Memory	487
169	Landmark	PC Diagnostics	467
010	Midwest Computer Works	Mail Order	484
215	Olympic Computer Systems	O.C.T. Systems	443
216	P.C. Innovation Computers	486 Desktops	442
145	Pacific Wave Technology	Mail Order, Hardware, Software	465
199	PC Zones	Mail Order	468-471
324	Peripheral Express	Hardware/Peripherals	489
314	Publishing Perfection	Hardware,Software,Peripherals	491
373	Software Add-Ons	Software, Mail Order	466
280	Tandy Direct	Victor 386L25	429
045	Tangent Computer, Inc.	LANs, Systems, Servers	457
206	TELEMART	Mail Order	481-483
121	Tri-Star Computers	Systems, Mail Order	414
322	US Systems & Technologies	Notebooks	430-431
149	USA Flex	Mail Order	447
189	USA Flex	USA Flex Systems	448-449
210	USA Flex	Mail Order	450-451
160	USA Flex	Peripherals	452-453
163	USA Flex	Printers	454-455
204	Vortex Computers	Laptops, Mail Order	462

PC-FAX

105	Computer Peripherals Inc.	14.4 Fax Modem	4

PERIPHERAL SHARING DEVICE

008	ASP Computer Products	Server Jet	86
328	Buffalo Products	Printer Sharing	492

PERIPHERALS

328	Buffalo Products	Printer Sharing	492
056	Okidata	LED Printer	147
235	Okidata	Dot Matrix	239
092	PCs Compleat	Peripherals	460-461
*	Quill Corporation	PC's	458-459

PORTABLE/LAP COMPUTERS

112	Agatech	Agatech PC's	444-445
089	Aurum Computers	Notebook Computers	249
012	Austin Computer Systems	Austin Notebooks	13-15
137	Compaq Computer	Compaq Product Micro-Age	257
126	CompuAdd	CompuAdd Systems	183-186
128	CompuAdd Express	CompuAdd Express Systems	211-214
357	CompuDyne	Compudyne Notebooks	314-315
109	Computer Discount Warehouse	Laptops	476-479
*	Dell Computer Corporation	Dell Systems	CS-C8
*	Dell Computer Corporation	Dell Systems	306-307
*	Dell Computer Corporation	Dell Systems	339
119	Edge Technology	Edge Technology PC's	416-417
*	EPS Technology	Notebooks	433-436
305	Expo Tech	Notebooks	440-441
*	Gateway 2000	Notebooks	48a-h
*	Gateway 2000	Peripherals	48a-h
066	IBM Corporation	Thinkpad Laptops	66-67
024	IBM Corporation	Thinkpad Laptops	130-131
*	Northgate Computer Systems	Notebooks	242-243
*	Northgate Computer Systems	Notebooks	350-351
215	Olympic Computer Systems	O.C.T. Systems	443
199	PC Zones	Mail Order	468-471
*	Quill Corporation	Notebooks	458-459
104	Swan Technologies Inc.	PC's, Mail Order	341-342
289	Tandy Direct	Victor 386L25	429
304	Texas Instruments	TI Travel Mate 4000	104-105
379	Toshiba America	T4400 Family	76-77
*	US Systems & Technologies	Notebooks	260
*	US Systems & Technologies	Notebooks	374
*	US Systems & Technologies	Notebooks	397
322	US Systems & Technologies	Notebooks	430-431
189	USA Flex	USA Flex Systems	448-449
210	USA Flex	Notebooks	450-451
204	Vortex Computers	Laptops, Mail Order	462
211	Xircom	Laptops	152
*	Zenith Data Systems	Notebooks	271-278
125	Zeos Int'l	Zeos Pocket PC	90
038	Zeos Int'l	Zeos Color Notebook	268
152	Zeos Int'l	Zeos Freestyle/SL	319-324

POWER PROTECTION

162	American Power Conversion	Back UPS	98
080	Pc Power & Cooling	Cooling Supplies	23

PRESENTATION SOFTWARE

348	Computer Associates	Windows Family	2-3
*	Lotus Development Corporation	Freelance Graphics for Windows	156-157
*	Microsoft	Powerpoint	20-21

PRINTER ACCESSORIES

008	ASP Computer Products	Server Jet	86
237	Lasermaster	Win Print Products	379
*	Pacific Data Products, Inc.	Pro Tracer	289

PRINTERS

008	ASP Computer Products	Server Jet	86
328	Buffalo Products	Printer Sharing	492
171	DataSouth Computer Corp.	XL Printer	263
*	Hewlett Packard Peripheral Group	HP LaserJet 4	134-135
*	Hewlett Packard Peripheral Group	HP DeskJet Portable	163
237	Lasermaster	Win Print Products	379
081	Lexmark International	Laser Printer	88-89
394	NEC Technologies	NEC Silentwriter 95x	72-73
056	Okidata	LED Printer	147
235	Okidata	Dot Matrix	239
324	Peripheral Express	Hardware/Peripherals	489
314	Publishing Perfection	Hardware,Software,Peripherals	491
141	QMS	Hammerhead Printer	357
353	Texas Instruments	TI Micro Laser Printers	280
160	USA Flex	Peripherals	452-453
163	USA Flex	Printers	454-455

PROGRAM DEVELOPERS/GENERATORS

138	IBM Corporation	CSet/2	18

PROGRAMMERS TOOLS UTILITIES

138	IBM Corporation	CSet/2	18

Advertisers' Index
PRODUCTS

Reader Service No.	Company	Product	Page
	PROJECT MANAGEMENT		
348	Computer Associates	Windows Family	2-3
140	Primavera Systems	Primavera Project Planner	46
*	Scitor Corporation	Project Scheduler 5.0	145
	REMOTE COMPUTING		
211	Xircom	Adapter	152
	RESELLERS		
137	Compaq Computer	Compaq Product Micro-Age	257
205	Compuclassics	Mail Order Products	473
108	Computer Discount Warehouse	Reseller	476-479
188	Dustin America	CD-ROM Products	398
347	Dustin America	Mail Order Products	406-407
352	FASTMICRO	Resellers	474-475
018	Midwest Computer Works	Resellers	484
203	Software Spectrum	WordPerfect for DOS & Windows	309
203	Software Spectrum	WordPerfect Office	309
206	TELEMART	Resellers	481-483
	RETAIL/DISTRIBUTORS		
137	Compaq Computer	Compaq Product Micro-Age	257
	SCANNERS/DIGITIZERS		
314	Publishing Perfection	Hardware,Software,Peripherals	481
	SERVERS		
046	Tangent Computer, Inc.	Servers	457
	SERVICE/SUPPORT		
144	Comp USA	CompCARE TechLine	472
	SOFTWARE		
388	CallSoft	Microsoft Multimedia	367
190	CallSoft	Software	369
177	Computer Express	Software	468
352	FASTMICRO	Software	474-475
102	Hunter Computer	Hardware, Software, Reseller	490
044	Icom Simulations	Graphics Software	224
344	Icom Simulations	Graphics Software	225
*	Insight Computers	Software	400-403
046	NEC Technologies	Select Solutions	99-101
145	Pacific Wave Technology	Software	485
082	PCs Compleat	Software	460-461
206	TELEMART	Software	481-483
	SPREADSHEET/TEMPLATES		
287	Borland International	Quattro Pro for Windows	56-57
*	Lotus Development Corporation	1-2-3 For Windows	94-95
*	Microsoft	Win Excel	C2-C4,p1
	STATISTICAL SOFTWARE		
365	Manugistics (formerly STSC)	Statgraphics	313
050	Mathsoft Inc	Maple V	291
365	STSC	Statgraphics	313
057/058	StatSoft	Statistical Software	305
147	Systat Inc	FASTAT	262
	TAX SOFTWARE		
*	Chipsoft Inc.	Tax Software	227
	TRACK BALLS		
027	Appoint, Inc.	Mouse Tools	265
	TRAINING/SEMINARS		
230	United Education Centers	Novell Education Center	391
	UTILITIES		
120	Avery Dennison	Label Pro	159
079	Central Point Software	Central Point Back Up	41
180	Dustin America	PC Kwick Power Pak	80
186	Symantec Corporation	Norton Utilities 6.01	28
350	Symantec Corporation	Norton Desktop for Windows	228
	VERTICAL MARKET SOFTWARE		
050	Mathsoft Inc	Maple V	291
057/058	StatSoft	Statistical Software	305
	VIDEO GRAPHICS/BOARDS		
337	ATI Technologies Inc	ATI Graphics Accelerators	245
302/320	First Source International	Memory, Mail Order	494
281	Number Nine Computer Corporation	#9GXe	74
104	Swan Technologies Inc	PC's, Mail Order	341-342
160	USA Flex	Peripherals	452-453
	WINDOWS SOFTWARE		
368	Adobe Systems Inc	Illustrator	96
285	Borland International	Quattro Pro for Windows	52-53
178	Claris Corporation	Filemaker Pro / Windows	106-107
348	Computer Associates	Windows Family	2-3
400	Computer Associates	AccPac Plus	5
044	Icom Simulations	Graphics Software	224
344	Icom Simulations	Graphics Software	225
*	Lotus Development Corporation	1-2-3 For Windows	94-95
*	Lotus Development Corporation	Ami Pro 2.0	127
143	Lotus Development Corporation	Ami Pro 2.0	129
*	Lotus Development Corporation	Freelance Graphics for Windows	156-157
263	Macola, Inc.	Accounting Software	219
050	Mathsoft Inc	Maple V	291
361	Micrografx	Designer Software	331
*	Microsoft	Powerpoint	C2-C2,p1
*	Microsoft	Windows for Workgroups	220-221
013	Microtac Software	Foreign Language Software	125
373	Software Add-Ons	Software, Mail Order	486
302	Software House	Windows for Workgroups	78
282	Software Spectrum	Microsoft Office for Windows	133
057/058	StatSoft	Statistical Software	305
350	Symantec Corporation	Norton Desktop for Windows	228
	WORD PROCESSING SOFTWARE/AIDS		
*	Lotus Development Corporation	Ami Pro 2.0	127
143	Lotus Development Corporation	Ami Pro 2.0	129
373	Software Add-Ons	Software, Mail Order	486
203	Software Spectrum	WordPerfect for DOS & Windows	309
	WORK GROUP SOFTWARE		
*	Microsoft	Windows for Workgroups	220-221
	WORKSTATIONS		
*	Quill Corporation	PC's	458-459
213	Sigma Data	Workstations	229

For Additional Categories See MARKETPLACE PRODUCT INDEX Page 497

PC MAGAZINE

Coming Up

The Best of 1992

What were the best products of 1992? What software and hardware products rose above the mundane or the routine? This popular annual feature reports our editors' personal favorites, their informed assessment of software and hardware products that they considered memorable during the previous year.

Video Technology

PC Magazine looks at the range of video technologies on the market and what new developments are in the works. We will offer a guide to the technology that best suits your needs as we consider video solutions from dumb-frame buffers to graphics accelerators to coprocessors, on a variety of buses.

Low-End Protocol Analyzers

Low-end protocol analyzers are great tools for network maintenance. But great protocol analyzers can make the art of network maintenance almost Zen-like; they won't break your budget, and they'll interpret what they find in clear, plain English. But which one is right for your LAN? PC Magazine Labs decides.

Faster Windows

Graphics accelerators boards speed up Windows, CAD, and other graphics applications by taking the strain off the CPU. PC Magazine Labs tests over forty of them, based on chips from S3, Texas Instruments, Cirrus, and more. Our new benchmark tests will let you pick the hares from the tortoises without emptying your wallet.

Personal Financial Software

When you enter transactions in electronic checkbooks, you can track expenses, manage budgets, and evaluate investments at the same time. Come April 15 you can even estimate your tax bill and transfer the information to your favorite tax preparation program. *PC Magazine* looks at the latest offerings from the major personal finance vendors.

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If your icons are never where you want them to be, PMTIDY, next issue's utility, will help you put them in their place. PMTIDY saves your icons' location and display state (minimized, maximized, or normal) for each Group icon in Program Manager as well as all the items within your Groups. Then whenever you find your icons in disarray, simply select PMTIDY and your entire layout will be restored. □

Editorial Product Index

AFTER HOURS

Reader Service No.	Product	Company	Page
483	Links 386 Pro	Access Software Inc.	528
484	Summer Challenge	Accolade Inc.	528
473	PC Game Pad	Advanced Grave Computer Technology Ltd.	528
488	Zagat-Axxis CityGuide	Axxis Software Inc.	528
569	Amaze Daily Planner, Version 2.0	Amaze Inc.	528
568	Where in the USA Is Carmen Sandiego? Deluxe Edition	Broderbund	528
487	Heaven & Earth	Buena Vista Software	528
477	Dark Seed	Cyberdreams	528
562	Composer Quest	Dr. T's Music Software	528
563	KidDesk	Edmark Corp.	528
475	Sherlock Holmes, Consulting Detective	ICOM Simulations Inc.	528
491	Great Wonders of the World, Volume I	InterOptica Publishing Corp.	528
485	Battle Chess MPC	Interplay Productions	528
570	Quicken 6.0	Intuit Inc.	528
564	Buzz Aldrin's Space Adventure	Knowledge Adventure Inc.	528
480	A-Train	Maxis	528
582	Andrew Tobias' Managing Your Money, Version 9.0	MECA Software Inc.	528
565	Storybook Weaver	MECC	528
572	Audio Port	Media Vision	528
481	Tom Landry Strategy Football	Merit Software	528
571	Notebook PC Travel Kit	MicroComputer Accessories	528
492	Microsoft Cinemania	Microsoft Corp.	528
482	Microsoft Golf for Windows	Microsoft Corp.	528
561	Music Mentor	Midisoft Corp.	528
560	Studio for Windows	Midisoft Corp.	528
493	Oxford English Dictionary	Oxford University Press	528
476	The Dagger of Amon Ra	Sierra On-Line Inc.	528
489	World Atlas	The Software Toolworks	528
478	Falcon 3.0	Spectrum HoloByte	528
486	Super Tetris	Spectrum HoloByte	528
474	Command Control Pad	Suncom Technologies Inc.	528
567	Time Riders in American History	The Learning Co.	528
490	Mars Explorer	Virtual Reality Laboratories Inc.	528
566	Follow the Reader	Walt Disney Computer Software	528
479	Stunt Island	Walt Disney Computer Software	528

COMPUTERS

Reader Service No.	Product	Company	Page
523	AcerAnyWare V386SL	Acer America Corp.	159
573	ALR Ranger M425s-120, ALR Ranger MC425s-120, ALR Ranger M425-120, ALR Ranger MC425-120	Advanced Logic Research Inc.	162
574	Altima 325 80386SL, Altima 433 80486DX	Altima Systems Inc.	172
590	American Mitac 3025F, American Mitac 3027F	American Mitac Corp.	189
577	Amrel MLT486DXU33	Amrel Technology Inc.	189
578	Aquline 433	Aspen Computer Inc.	198
424	AST PowerExec	AST Research Inc.	51
580	Austin 386/SXL-25 Notebook	Austin Computer Systems Inc.	199
581	AVI AN83-386SXL-25	AVI Systems Inc.	199
524	BLK 386SL/25NBF	Blackship Computer Systems Inc	215
525	Chaplet 386 SL25 Notebook	Chaplet Systems USA Inc.	215
527	Compaq Contura 3/20, Compaq Contura 3/25	Compaq Computer Corp.	216
408	Compaq Contura 3/25c	Compaq Computer Corp.	59
583	Compaq LTE Lite/25c	Compaq Computer Corp.	268
526	Compaq LTE Lite/25E	Compaq Computer Corp.	217
528	CompuAdd Express 425CXL-80	CompuAdd Express	217
576	Compudyne Slimnote 386SL/25-80, Compudyne [redacted]	Compudyne Products	172
531	Dell Dimension NL20	Dell Computer Corp.	218
529	Dell System 320SLi	Dell Computer Corp.	219
530	Dell System 325N	Dell Computer Corp.	222
532	DECpc 325p	Digital Equipment Corp.	222
533	DTK Grafika 3N	DTK Computer Inc.	225
579	Ergo 486DX-33 NoteBrick II	Ergo Computing Inc.	198
534	Everex Carrier SL/25	Everex Systems Inc.	226
535	GRiD Convertible	GRiD Systems Corp.	226
591	GRiD 1860, GRiD 1755 486SLC	GRiD Systems Corp.	222
536	IBM PS/note N45si	IBM Personal Computer Co.	229
430	IBM ThinkPad 700C	IBM Corp.	44
537	Identity 386SXL-25 Notebook	Identity Systems ComputerTechnology Inc.	230
538	Jetta Jetbook 486DX/33	Jetta International Inc.	230
584	Color Keynote 386SL-25	Keydata International Inc.	269
539	Keynote 386SX-25, Keynote 486SLC	Keydata International Inc.	237
540	Leading Edge N3/SL25 Plus	Leading Edge Products Inc.	238
541	Librex T386SX	Librex Computer Systems Inc.	238
542	Librex R386SL	Librex Computer Systems Inc.	240
588	Lightning Thundernote 486DX/33	Lightning Computers	172
592	Matrix 486SX-25Mhz Notebook	Matrix Digital Products Inc.	240
543	Mitsuba Ninja 486SX	Mitsuba Corp.	240
545	Micro Express NP933	Micro Express	244
546	Micro Express NB486DX	Micro Express	244
547	Dynova SLic3000	PC&C Research Corp.	246
548	Poly NB325T	Polywell Computers Inc.	246
549	Poly NBC25	Polywell Computers Inc.	248
544	Primax Eagle 425SX	Primax Corp.	248
550	Primax NightHawk 325SXL	Primax Corp.	250
551	Klonmus Lite 386SL/25	QSI Corp.	250
552	NoteMaster 386L/25	Samsung Electronics America	256
553	Tandy 3800 HD	Tandy Corp.	258
426	Tandy Sensation	Tandy Corp.	46
554	TI TravelMate 4000 WinSX/25, TI TravelMate 4000 WinDX/25	Texas Instruments Inc.	258
555	Toshiba Satellite T1800	Toshiba America Information Systems Inc.	259
556	Toshiba T3300SL	Toshiba America Information Systems Inc.	260
585	Toshiba T4400SXC	Toshiba America Information Systems Inc.	279
589	Twinhead Slimnote 486DX/33	Twinhead Corp.	172
557	DecisionMate 486SLC	Wyse Technology Inc.	261
558	Z-Note 320Lb, Z-Note 320L, Z-Note 325L	Zenith Data Systems	263
586	Z-Note 325Lc Model 120	Zenith Data Systems	290
559	Z-Sport 325S	Zenith Data Systems	264
587	Zeos Color Notebook	Zeos International Ltd.	291

HARDWARE

Reader Service No.	Product	Company	Page
403	Inspire II	Alphatronix Inc.	58
417	AC-1079MC	Arco Electronics	50
458	CD Porta-Drive Model T3301	CD Technology Inc.	308
459	Chinon CDC-435	Chinon America Inc.	310
418	Conner Peripherals Sol-Stor	Conner Peripherals	49
460	Hitachi CDR-3700, Hitachi CDR-3750	Hitachi Home Electronics (America) Inc., Multimedia Systems	312
461	LMS CM225	Laser Magnetic Storage International Co.	316
462	Liberty 115 Series CD-ROM	Liberty Systems Inc.	317
463	MacProducts Magic CDR74, MacProducts Magic 3301 Toshiba	MacProducts USA Inc.	325
464	NEC InterSect CDR-37, NEC InterSect CDR-74	NEC Technologies Inc.	328
408	Pacific Data Connect Xi, Pacific Data 4 SIMM Printer Memory, The Complete Font Library, 25 in One! III	Pacific Data Products	62
465	Philips CM-205XRS	Philips Consumer Electronics Co.	330
466	PLI CD-ROM Drive	PLI	330
467	Procom PXCDL, Procom SXCDS-C8	Procom Technology Inc.	332
407	LanRover/4E, LanRover/8E	Shiva Corp.	59
468	Sony CDU-31A-02, Sony CDU-7211	Sony Corp. of America	333
469	Storage Devices SCD-683	Storage Devices Inc.	337
470	Tandy CDR-1100	Tandy Corp.	338
471	Texel DM-5024	Texel	340
472	Todd TCDR 7000, Todd TCDR 7050	Todd Enterprises Inc.	343

PRINTERS

Reader Service No.	Product	Company	Page
427	Canon Computer Systems BJ-200	Canon Computer Systems Inc.	40
411	Canon Computer Systems LBP-4sx Canon Computer Systems LBP-8sx	Canon Computer Systems Inc.	83
419	Pacific Data ProTracer	Pacific Data Products	55

READ ONLY

Reader Service No.	Product	Company	Page
456	Outside the IBM PC and PS/2	Brady	73
457	PC Power! Boosting Your PC's Performance	M&T Books	73

SOFTWARE

Reader Service No.	Product	Company	Page
414	Star Trek: The Screen Saver	Berkeley Systems	63
520	Variety's Video Directory Plus	Bowker Electronic Publishing	369
507	Just Grandma and Me	Broderbund Software Inc.	354
509	Where in the World is Carmen Sandiego?, Deluxe Edition	Broderbund Software Inc.	354
500	Great Literature Personal Library Series	Bureau Development Inc.	349
423	Image Assistant, Version 1.0	Caere Corp.	48
	PC Tools, Version 8.0	Central Point Software	
428	FileMaker Pro for Windows, Version 1.0	Claris Corp.	37
504	1991 TIME Magazine Compact Almanac	Compact Publishing	352
498	Compton's MultiMedia Encyclopedia for Windows	Compton's NewMedia	348
404	Support On Site for Networks	Computer Library	58
495	Street Atlas USA	DeLorme Mapping Co.	347
515	Composer Quest	Dr. T's Music Software Inc.	357
519	Renaissance Masters I	Ebook Inc.	369
402	Fractal Design Sketcher for Windows, Version 1.0	Fractal Design Corp.	56
415	AddImpact!, Version 1.0	Gold Disk	49
499	New Grolier Multimedia	Grolier Electronic Encyclopedia Publishing Inc.	349
410	HP NewWave, Version 4.1	Hewlett-Packard Co.	62
513	Berlitz: Think & Talk French	HyperGlot Software Co. Inc.	356
512	Sherlock Holmes: Consulting Detective	ICOM Simulations Inc.	356
501	Great Wonders of the World, Volume 1	Interoptica Limited	349
510	Battle Chess Enhanced CD-ROM	Interplay Productions Inc.	356
496	Macmillan Dictionary for Children	Macmillan New Media	348
502	McGraw Hill Science and Technical Reference Set, Release 2.0	McGraw Hill Inc.	352
517	CD-ROMs in Print 1992: An International Guide to CD-ROM, CDI, CDTV and Electronic Book Products	Meckler	357
405	HALO Desktop Imager, Version 2.0	Media Cybernetics Inc.	59
514	Cinemania	Microsoft Corp.	357
503	Microsoft Bookshelf, 1992 Multimedia Edition	Microsoft Corp.	352
425	Microsoft Money, Version 2.0	Microsoft Corp.	51
518	Multimedia Beethoven: The Ninth Symphony	Microsoft Corp.	357
401	Video for Windows, Version 1.0	Microsoft Corp.	58
522	Mammals: A Multimedia Encyclopedia	National Geographic Society Educational Services	369
497	The Oxford English Dictionary, Second Edition, on Compact Disc	Oxford University Press, Electronic Publishing	348
409	PC-Kwik Power Pak, Version 3.0 Super PC-Kwik, Version 5.0	PC-Kwik Corp.	62
413	FYPlan for Windows, Version 1.0	Pilar Corp.	63
422	Q+E, Version 5.0	Pioneer Software	55
421	SurveyFirst, Version 1.0	Racosoft	50
511	King's Quest V	Sierra On-Line	356
508	Mixed Up Mother Goose	Sierra On-Line	354
420	SmartForecasts, Version 3.0	Smart Software	54
506	Annabel's Dream of Ancient Egypt	Texas Caver Inc.	354
505	Vital Signs: The Good Health Resource	Texas Caver Inc.	352
494	Software Toolworks World Atlas MPC	The Software Toolworks	347
516	The CD-ROM Directory	UniDisc	357
521	Distant Suns	Virtual Reality Laboratories	369
418	American Heritage Dictionary, Second Edition	WordStar International	54

TOOLKITS

Reader Service No.	Product	Company	Page
451	zApp for DOS and Windows, Version 1.1	InMark Development Corp.	77

PROGRAMMING

User-to-User ..... A tiny utility program that lets you try out the Dvorak keyboard layout. 371
User-to-User ..... Tips to enhance your use of DOSKEY macros. 371
Tutor ..... Locking and unlocking your hard disk. 373
Utilities ..... Batch files get even better with STRINGS 2.0. 375
Environments ..... Exploring the FONTMETRICS Structure, Part 1. 388
Power Programming ..... Multitasking and multithreading in Windows NT. 392
SOLUTIONS 408
PCs ..... Make sure your new devices get the IRQs they need. 408
Peripherals ..... Keeping track of printer usage. 408
Peripherals ..... Searching for the ideal multipurpose peripheral. 408
Operating Environments ... A shortcut key to access Program Manager. 411
Operating Environments ... Running DOS games under OS/2 2.0. 411
Word Processing ..... Give your WordPerfect graphics a more professional look. 412
Word Processing ..... Sharing dictionary files between Word for Windows and Excel. 412
Spreadsheets ..... A short macro that will maximize your start-up sheet. 418
Spreadsheets ..... A formula that returns the name of a page in Quattro Pro for Windows. 418
Databases ..... An undocumented property of DOS that checks for a subdirectory's existence. 428
Graphics ..... Creating realistic perspective space in CorelDraw. 438
Graphics ..... Precisely align your Animator Pro animations. 438
Networking ..... Why Burst Mode doesn't work with Windows—yet. 446
Networking ..... Sharing spreadsheet data over a LAN. 446
Languages ..... Standard C macros that make it easy to create variable argument functions in C and C++. 446
On-Line ..... Logging on to ZiffNet with Procomm Plus. 466

After Hours

HOLIDAY GIFT GUIDE

Holiday Software

BY JULIE COHEN

Don't bother Santa Claus. He's still pondering which database will help him keep track of all those presents, elves, and reindeer. Instead, turn these pages, and get more than 30 ideas for some of the best software gifts for your family.

In our fourth annual gift-giving guide, we make our recommendations for hardware and software that will challenge game lovers, enthrall music fans, stimulate children's imaginations, and get everybody—maybe even Santa—a little more organized for 1993.

A Cornucopia of Games: Adventures, Sports, Puzzles to Boggle the Mind

Game players can delight in the choices they have available this season: a wide range of action adventures, brainteasers, and sporting events from track and field to football. CD-ROM-based adventures and 3-D graphics began to come into their own this year, and almost anything could be viewed as if on a VCR.

When you choose a game, make sure you have the right PC. Many complex games take as much as 20MB of hard disk space and require VGA graphics; some, like Falcon 3.0, practically demand 486 technology. The accessory of choice for a simple Nintendo replacement? You can choose a conventional joystick or mouse, or pick a device that resembles a Nintendo control pad, such as the **PC Game Pad** from Advanced Gravis Computer Technology (29.95) or Suncom Technologies' **Command Control Pad** ($29.99).

As the heroine, Laura Bow, you capture the murderer and save the day in The Dagger of Amon Ra.

MYSTERY AND ADVENTURE

Although the Ultima, Might & Magic, King's Quest, and other fantasy game series are aimed at the post-Dungeons & Dragons crowd, adventure game makers are looking beyond the dungeon with games that appeal to both men and women.

Who can resist a good Sherlock Holmes mystery, for example? In the CD-ROM–based **Sherlock Holmes: Consulting Detective** ($69.95) from ICOM Simulations, you work with Sherlock Holmes and Dr. Watson to solve each of three separate cases. You visit and interrogate dozens of suspects until you solve the mysteries. The developers of this game wrote the scripts, constructed 25 Victorian sets, and designed 70 costumes; ICOM packed all 90 minutes of 15-frame-per-second video onto the CD-ROM.

Swiss surrealist H.R. Giger's horrific graphics make Dark Seed nightmarish fun.

It's refreshing to see an adventure whose hero is a woman. The star of Sierra On-Line's roaring twenties mystery-adventure, **The Dagger of Amon Ra** ($69.95), is Laura Bow, a cub reporter who must solve seven murders, uncover the thief of a prized Egyptian artifact, and prevent herself from being pickled alive over the course of an evening at an art museum's fundraiser. The hand-painted, 256-color graphics and entertaining plot make Amon Ra a fine adventure for those who prefer a good mystery to a crawl through the dungeon.

In A-Train, you build up your community by building the rail system.

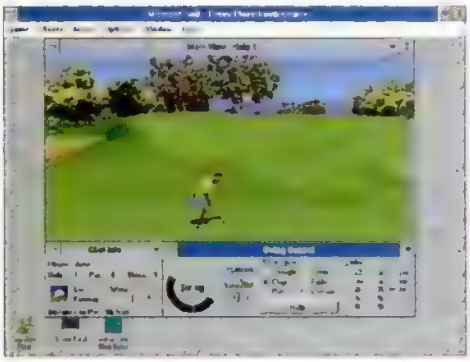
For those who love a good nightmare, Cyberdreams' evil adventure game, **Dark Seed** ($69.95), features stunning artwork from the Swiss surrealist who created the creature from *Alien*. Cyberdreams filmed and digitized actors' movements to achieve realistic action, and created more than 75 scenes to explore in this challenging, complex game.

TAKE THE TRAIN OR THE PLANE

Serious flight simulation fans who have the right hardware—a 486, DOS 5.0, and tons of memory—should con-

Games

sider Spectrum HoloByte's **Falcon 3.0** ($79.95). One of the most realistic simulations available, Falcon puts you in the cockpit of an F-16, fighting enemies over Kuwait, Israel, and Panama. You can play against the computer, on a network, or via modem.



Microsoft and Access teamed up to make golf as realistic under Windows as Links 386 Pro is under DOS.

For another type of action, Disney's **Stunt Island** ($59.95) lets you be pilot, director, producer, and audience. As you guide your aircraft over and through barns and other obstacles, you record your own actions for later viewing. In the cutting room you can edit the scenes from almost any angle, and play back the flight as a short movie.

Many people prefer building cities and infrastructures to blowing them up. Maxis' **A-Train** ($69.95) takes one facet of SimCity—the rail system—and challenges would-be tycoons to expand commerce in a whole region. As in SimCity, you work hard to keep finances in order and your citizens happy; as you invest in different industries, your empire grows.

LET THE GAMES BEGIN

Football season is almost over. The Olympics won't be back till 1994. And when's the next time you'll be on a golf course? Here is a selection of games that let fans participate in their favorite sports all year round.

Merit Software's **Tom Landry Strategy Football** ($49.95) makes you the coach of your own team. In this simulation, you map out your coaching strategies, play against another opponent or the computer, and then you can view your actions and replay them. Tom Landry, who spent years as the coach of the Dallas Cowboys team, lends his advice for more than 100 game situations.

For track and field fans, Accolade's **Summer Challenge** ($54.95) lets up to ten players compete for the gold in eight Olympic sports: pole vaulting, archery, cycling, the 400-meter hurdle, javelin throwing, kayaking, the high jump, and equestrian events. The more you train your athletes, the better they'll perform.

The best golf game is still Links, and now you can play the game under Windows or DOS. Access Software introduced **Links 386 Pro** ($69.95), an upgrade to last year's version that brings sound and high-resolution graphics to the course. At about the same time, Microsoft teamed up with Access and brought out **Microsoft Golf for Windows** ($64.95). The package ships with the Torrey Pines course, but is compatible with other Links courses. The scanned-in images of these championship courses; 360-degree views; male and female players; and total control of clubs, stance, and swing plane make these two versions of the game the ones to beat.

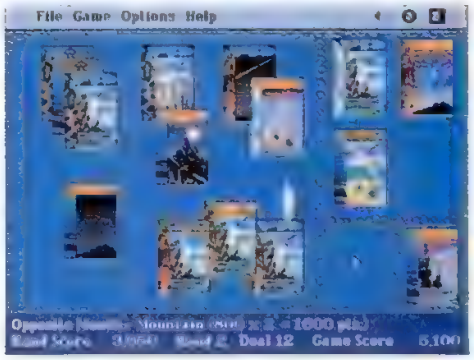
Where in the USA is Carmen Sandiego: the classic children's game gets a deluxe update.

Okay, so chess isn't usually a big spectator sport. However, Interplay Productions' **Battle Chess MPC** ($79.95) combines the strategy of chess with battling that would make even a gladiator proud. The animated 3-D chess pieces perform slapstick antics, and the package itself is a reasonably challenging opponent. Don't miss the 30-minute tutorial, in which each chess piece demonstrates its capabilities in a highly imaginative performance. The only multimedia chess game, Battle Chess MPC requires a system with 3MB RAM, an MPC compatible CD-ROM drive, and the Windows 3.1 Multimedia Extensions.

PUZZLING ADDICTIONS

Remember Tetris, whose blocks fell as the hours disappeared? Spectrum HoloByte reissued this classic game as **Super Tetris** ($49.95), with new screens and new challenges, but with the same addictive nature of the original. In this version, available for both DOS and Windows, you must keep the rows on the top half of the screen clear, while you excavate the bottom half of the screen using the game's falling bombs.

Similar in its addictive nature, the pendulum, mazes, and card games in Buena Vista Software's **Heaven & Earth** ($49.95) will mesmerize even the most cerebral game players. This not-quite-Zen package features beautiful renderings, puzzles that can take anywhere from 30 seconds to several hours to solve (depending on your patience level), and philosophical reminders that you'll probably welcome after staring at the screen for hours.



Heaven & Earth takes a somewhat Zen approach to gaming, yet may be as addictive as Tetris.

PC Game Pad
Advanced Gravis Computer Technology Ltd., Burnaby, BC, Canada; 604-431-5020.
Circle 473 on reader service card

Command Control Pad
Suncom Technologies, Niles, IL; 708-647-4040.
Circle 474 on reader service card

Sherlock Holmes: Consulting Detective
ICOM Simulations Inc., Wheeling IL; 708-520-4440.
Circle 475 on reader service card

The Dagger of Amon Ra
Sierra On-Line Inc., Coarsegold, CA; 209-683-4468.
Circle 476 on reader service card

Games

Dark Seed
Cyberdreams, Woodland Hills, CA; 818-348-3711.
Circle 477 on reader service card

Falcon 3.0
Spectrum HoloByte, Alameda, CA; 510-522-3584.
Circle 478 on reader service card

Stunt Island
Walt Disney Computer Software, Burbank, CA; 818-973-4015.
Circle 479 on reader service card

A-Train
Maxis, Orinda, CA; 510-254-9700.
Circle 480 on reader service card

Tom Landry Strategy Football
Merit Software, Dallas, TX; 214-385-2353.
Circle 481 on reader service card

Microsoft Golf For Windows
Microsoft Corp., Redmond, WA; 206-882-8080.
Circle 482 on reader service card

Links 386 Pro
Access Software Inc., Salt Lake City, UT; 801-359-2900.
Circle 483 on reader service card

Summer Challenge
Accolade Inc., San Jose, CA; 408-985-1700.
Circle 484 on reader service card

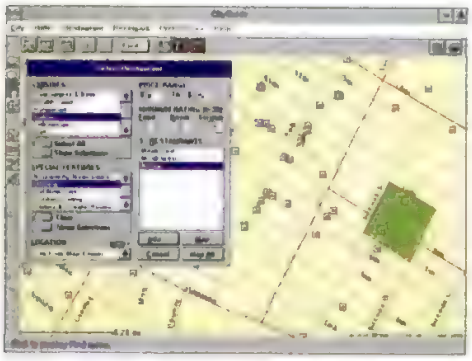
Battle Chess MPC
Interplay Productions, Santa Ana, CA; 714-545-9001.
Circle 485 on reader service card

Super Tetris
Spectrum HoloByte, Alameda, CA; 510-522-3584.
Circle 486 on reader service card

Heaven & Earth
Buena Vista Software, Burbank, CA; 818-841-3326.
Circle 487 on reader service card

The Armchair Adventurer: Reference Titles to Explore

CD-ROM technology has made the reference category more feasible than ever. Entire volumes of data can be compressed onto one disk. To bring multimedia home, you could stock a PC with a CD-ROM drive and a sound card. Or you can buy a plug-and-play model such as Packard Bell's PB 486SX/25 Multimedia or Tandy's Sensation. The six packages we've reviewed here represent some of the best multimedia gifts.



Zagat-Axxis' CityGuide can help you select a restaurant or hotel, and help you get there.

AROUND THE WORLD AND BACK

Axxis Software has teamed up with Zagat and ETAK to present a solution for the lost and hungry. The **Zagat-Axxis CityGuide** ($99.99) is a database of more than 1,000 restaurants and dozens of hotels and landmarks, with an edition for each of three major cities: New York, Chicago, and Los Angeles. The software improves on the Zagat books by letting you search for a hotel or restaurant based on any criteria you choose, then finds the fastest way to get there. Are you prone to craving Tandoori chicken at 2 A.M.? Search for Indian restaurants open after midnight. CityGuide maps out the best route.

Perhaps you're looking for a map of India, rather than a New York interpretation of the country's cuisine. The Software Toolworks' **World Atlas** ($149.95) contains information on the geography, people, governments, economies, and other topics pertaining to more than 200 countries. Software Toolworks gives users a choice: The MPC version requires a CD-ROM drive and Microsoft's MS-DOS CD-ROM Extensions, and about 500K of hard disk space. This version brings pronunciation guides, national anthems, and audio help to an already extensive package. The disk-based version ($79.95) takes about 6MB of disk space and lacks the MPC version's audio capabilities.

Maybe you don't even want to stay on the planet. Virtual Reality Laboratories' **Mars Explorer** ($69.95) takes you on a journey to the Red Planet. If you imagine sitting in a jeep and riding across the Red Planet's equator, that's what you will see as you scroll through more than 200MB of footage from NASA's Viking photo mission. More than just an entertaining ride, this package contains descriptions of each of the journeys, and allows users to save and display images in .PCX format.

If you prefer to explore some of the more down-to-earth feats of man, **Great Wonders of the World, Volume 1** ($79.95), from InterOptica Publishing Corp., is worth exploring. A follow-up to last year's Great Cities of the World, Great Wonders presents an entertaining, informative, and interactive look at architectural masterpieces such as Peru's Inca ruins, the Great Wall of China, and the Empire State Building. Though Great Wonders focuses on only seven subjects, the package explores them thoroughly, with slides, maps, and megabytes of data about the builders of each.

WORDS AND PICTURES

Movie fanatics can spend hours with Microsoft's **Cinemania** ($79.95). This package documents more than 19,000 films from 1914 to 1991, and contains bios of nearly 3,000 movie personalities. Based on Leonard Maltin's Movie and Video Guide 1992, Cinemania uses the CD-ROM format and an intuitive interface to give the browser easy access to movie stills, portraits of actors and actresses, and sound clips.

Great Wonders of the World, Volume 1, provides an in-depth exploration of seven great architectural feats.

For the writer or scholar, the **Oxford English Dictionary** has a high price tag, but is ultimately a great investment. At $895, the Oxford English Dictionary is less expensive than the multivolume hardcover version, has superior search capabilities, and is rich

Reference

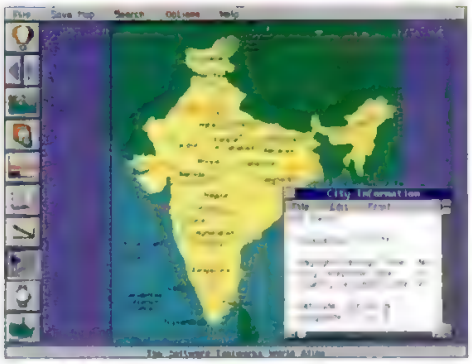
with the history of language.

Zagat-Axxis CityGuide
Axxis Software Inc., Haverford, PA; 215-896-0576.
Circle 488 on reader servic card

World Atlas
The Software Toolworks, Novato, CA; 415-883-3000.
Circle 489 on reader service card

Mars Explorer
Virtual Reality Laboratories Inc., San Luis Obispo, CA; 805-781-2250.
Circle 490 on reader service card

Great Wonders of the World, Volume 1
InterOptica Publishing Corp., San Francisco, CA; 415-788-8788.
Circle 491 on reader service card



The MPC version of World Atlas includes national anthems and audio help for more than 200 countries.

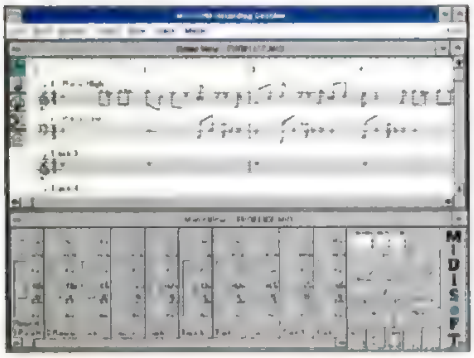
Microsoft Cinemania
Microsoft Corp., Redmond, WA; 206-882-8080.
Circle 492 on reader service card

Oxford English Dictionary
Oxford University Press, New York, NY; 212-679-7300.
Circle 493 on reader service card

Not for Composers Only: MIDI Woos Music Lovers

The right MIDI equipment can turn a PC into a fantastic musical tool. With a sound card, amplifier, and keyboard, dabblers can learn about music by hearing and playing it; musicians can record, edit, arrange, print, and play their compositions.

Among the best sequencers available is Midisoft's **Studio for Windows** ($249.95). As you play your MIDI keyboard, Studio for Windows records your piece in standard music notation—a feat other sequencers have yet to accomplish. When you listen to a composition, each note on every track is highlighted as it's played. The package has a wide range of editing capabilities, and can print a score once you're satisfied with your composition. Studio for Windows supports Roland, Sound Blaster, Ad Lib, and Pro Audio Spectrum sound cards, among others.



Music Mentor lets users learn about music history and styles while they view and edit the notation.

To learn about music history, theory, and styles while you learn to compose, Midisoft's **Music Mentor** ($149.95) combines an interactive music tutorial with recording and editing software. The tutorial covers five major musical styles in Western music history, describing and illustrating the basic attributes of each: melody, rhythm, harmony, timbre, texture, and form. The listener can view each piece of music as it plays, and then play, record, or edit using Recording Session, the sequencing software that comes with the package. Like Studio for Windows, Music Mentor requires a system with Windows 3.0 or later, as well as a MIDI interface or any sound card supported by Windows, Version 3.1.

By comparison, **Composer Quest** ($99), from Dr. T's Music Software, focuses on the creators—rather than the styles— of the music. This multimedia CD-ROM title provides biographies, pictures, and examples of music by 32 composers from the 17th century to the present. The listener learns to identify different styles, periods, and composers through a game that gives the player a segment from a famous piece of music and a series of clues about the composition and its creator.

Studio For Windows
Midisoft Corp., Bellevue, WA; 206-881-7176.
Circle 560 on reader service card

Music Mentor
Midisoft Corp., Bellevue, WA, 206-881-7176.
Circle 561 on reader service card

Composer Quest
Dr. T's Music Software, Needham, MA, 614-455-1454.
Circle 562 on reader service card

Holiday Learning Fun: Children's Software Gets Smarter

A family PC should do more than let your children play games. With the right setup, young kids can learn with computers before they can read; older ones can spend hours exploring topics in science, history, and geography.

If you have young children, consider a product such as Edmark's **KidDesk** ($39.95), a DOS shell that gives each child access to only the programs the adult selects. Unlike other shells, this one resembles the child's own desktop, with icons and tools that will please young computer users.

Fourth in Knowledge Adventure's innovative multimedia-on-a-hard-disk series, **Buzz Aldrin's Space Adventure** ($79.95) explores the realm of outer space, and will appeal to children and parents of all ages. Younger users will enjoy the pictures and interactive experiments; older ones will remember the 5- and 10-second video clips of relevant moments in history. There's one clip of John F. Kennedy as he commits the U.S. to landing on the moon, as well as footage of the Eagle as it touches down and fulfills Kennedy's dream. Like Knowledge Adventure, Sports Adventure, and Isaac Asimov's Science Adventure (three equally engaging holiday gift choices), this package

Children's Software

requires little more than a 386-based computer with a hard disk and a sound card.

Two products help kids improve their reading skills by letting them write, illustrate, and print their own stories. MECC's **Storybook Weaver** ($49.95) gives children from ages 6 to 14 a vast menu of words and richly colored images to combine and create their tales. For Mickey Mouse fans, Walt Disney Computer Software has released **Follow the Reader** ($49.95). The package lets 5- to 9-year-olds create their own Disney stories. Presented with a still scene of Mickey Mouse and his friends, the child animates the story by clicking on key nouns and verbs on the lower half of the screen. Stories can be saved and played back, and can be printed out complete with the illustrations.

KidDesk lets parents select only the programs they want their children to access.

HISTORY REWRITTEN

What the Carmen Sandiego series did for geography, The Learning Company's **Time Riders in American History** ($49.95) does for history. In this educational game, children ages ten and older must stop the villain, Thanatopsis Dread, from rewriting history by broadcasting false headlines over the newswires. The game requires no other books; a database of information is built in, covering events from 1492 to 1905.

Of course, Carmen is back, too, with a deluxe version of a favorite: Broderbund's **Where in the USA is Carmen Sandiego, Deluxe Edition** ($79.95) has gotten the same treatment as last year's deluxe update of Where in the World is Carmen Sandiego. Both packages feature high-resolution VGA graphics, animation, music, and Carmen herself.

Children write and illustrate their own books, using MECC's Storybook Weaver.

KidDesk
Edmark Corp., Redmond, WA; 206-556-8400.
Circle 563 on reader service card

Buzz Aldrin's Space Adventure
Knowledge Adventure Inc., La Crescenta, CA; 818-542-4200.
Circle 564 on reader service card

Storybook Weaver
MECC, Minneapolis, MN; 612-569-1500.
Circle 565 on reader service card

Follow The Reader
Walt Disney Computer Software Inc., Burbank, CA; 818-841-3326.
Circle 566 on reader service card

Time Riders in American History
The Learning Co., Fremont, CA; 510-792-2101.
Circle 567 on reader service card

Where in the USA is Carmen Sandiego? Deluxe Edition
Broderbund, Novato, CA; 415-382-4400.
Circle 568 on reader service card

Holiday Reading

For wealthy Cyberpunk literati: William Gibson's *Agrippa* destroys itself as you read it. Two versions of the limited-edition electronic novel are available: a $450 version in a cloth box, with reproductions of DNA etchings by artist Dennis Ashbaugh, and a $1,500 version, in a bronze box with Ashbaugh's original etchings. (Kevin Begos Publishing, New York, NY.)

For the rest of us, there's *Accidental Empires* ($19.95), Robert X. Cringely's gossipy account of the PC industry's brilliant but socially inept founding fathers. Cringely skewers Microsoft's "billionaire boy chairman" Bill Gates, Steve Jobs, and Mitch Kapor, among others, but provides insight into an industry run by people who, Cringely contends, have no business being in any other business. (Addison Wesley Publishing, Reading, MA.)

New Year's Resolutions: Organize Your Finances and Your Life

Who hasn't made and broken countless New Years' resolutions? This year, perhaps you've promised to clean up your finances, get a little more organized, or even just read a bit more. Here are six products that will make those resolutions just a little easier to keep in 1993.

For keeping your schedule straight, you could buy a complicated PIM, or you could choose an easy-to-use calendar that simply adds a laugh to your daily routine. Amaze Software has updated the **Amaze Daily Planner, Version 2.0** ($69.95), with new crises for Cathy and more animated weirdness from The Far Side's Gary Larson. There's even a Trivial Pursuit version. The calendars feature an easy-to-use interface, with options for daily, weekly, or monthly planning. In the Cathy and Far Side calendars a different comic strip appears daily, and there are animated color cartoons that appear periodically as well. In the Trivial Pursuit version, a new card pops up each day. Amaze has enhanced its to-do lists and added drag-and-drop capability to the earlier versions of this package.

If it's finances or taxes you want to organize, try **Quicken 6.0** ($69.95) from Intuit, or **Andrew Tobias' Managing Your Money, Version 9.0** ($79.95), from MECA Software. Quicken 6.0 is notable for IntelliCharge—Intuit's ingenious electronic credit-card

Resolutions

link. With the Intellicharge VISA, users get electronic statements every month, and Quicken automatically pays the recurring bills. Managing Your Money helps you get ready to prepare your taxes, budget your money, pay your bills, and determine your net worth. The program also has an on-line link to Dow Jones and CompuServe's on-line stock-tracking services.

Amaze Daily Planner combines a powerful calendar engine with a daily Trivial Pursuit challenge.

TRAVEL LIGHT

The perfect gift for the traveling executive? The **Notebook PC Travel Kit** ($30), from MicroComputer Accessories. With this package, the traveler will always have the right phone cord, jack, cables, and tools for simple repairs all packed neatly in a compact, vinyl pouch. The travel kit also comes with clear tape, removable labels, reusable cable ties, a miniflashlight, and a reference card with phone numbers and DOS commands.

Media Vision's **Audio Port** ($199) lets you take MPC sound on the road. Even though it provides only 8-bit mono output, the device is ideal for a notebook computer because it connects to the parallel port rather than requiring a slot. The small, lightweight Audio Port contains a speaker, a microphone, volume control, and a connection for an external speaker.

Amaze Daily Planner, Version 2.0
Amaze Inc., Kirkland, WA; 206-820-4102.
Circle 569 on reader service card

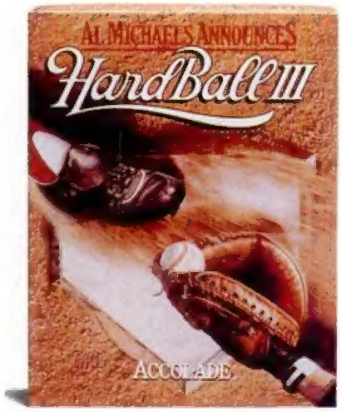
Quicken 6.0
Intuit Inc., Menlo Park, CA; 415-322-0573.
Circle 570 on reader service card

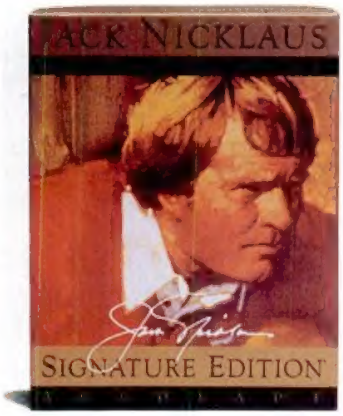
Andrew Tobias' Managing Your Money, Version 9.0
MECA Software Inc., Fairfield, CT; 203-256-5000.
Circle 582 on reader service card

Notebook PC Travel Kit
MicroComputer Accessories, Manhattan Beach, CA; 213-379-6104.
Circle 571 on reader service card

Audio Port
Media Vision, Fremont, CA; 510-770-8600.
Circle 572 on reader service card

Quicken 6.0 helps keep personal finances in order and links to Intuit's IntelliCharge credit card to provide users with convenient electronic billing.





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This holiday season, give your favorite sports fan the #1 selling sports games for the IBM PC and compatibles. *Al Michaels Announces HardBall III*™ and *Jack Nicklaus Golf & Course Design: Signature Edition.*™ Buy either game, and receive a HardBall III or Jack Nicklaus add-on disk absolutely FREE. (A $24.95 value.) Call 1-800-245-7744 to take advantage of this special holiday offer!

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CIRCLE 123 ON READER SERVICE CARD

Abort, Retry, Fail?

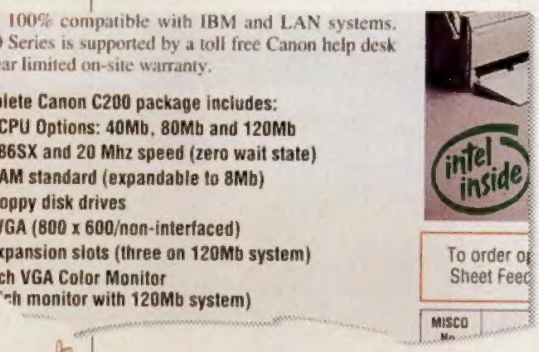
THE LIGHTER SIDE OF PERSONAL COMPUTING

By Bill Howard

New Math: This Staples office warehouse ad shows Maxell disks at $9.99 per box of ten. The ad says that's $1.40 per disk.

Tips for the Ultimate in Flicker-Free Monitors

"Minimize flicker by choosing a board that supports the VESA standard 72-MHz refresh rate."
SUPERCHARGING WINDOWS, BY JUDD ROBBINS, 1992, SYBEX INC. (72 Hz is the VESA standard.)



Misco's spring 1992 catalog offers a Canon C200-series PC with intriguing CPU options and a "non-interfaced monitor."

Mea Culpa

"Spikes are disturbances lasting only from a few nanoseconds to a millisecond (one millionth of a second) that can raise the voltage to more than 6,000 volts, distorting the contour of the AC waveform."
—*PC MAGAZINE*, SEPTEMBER 29, 1992
(A nanosecond is a billionth of a second; a millisecond is a thousandth of a second.)

Pentium: More Proof that All the Good Names Are Taken

Intel's new Pentium micro-processor, née P5 or 586. . . . Haven't we heard that name somewhere before?

- "Take two Pentium, get lots of rest, and call me in the morning."
- "Pentium: Isn't that one of the heavy metals on the periodic table of the elements?"
- "I spent all afternoon raking leaves and I aggravated my pentium."

Then there's the follow-on Intel 686. Think of the fun you'll have with a product name starting with *sex* . . . .

Amazing feat: This Lechmere department store flier shows a Mac Performa running Windows.

More New Math

"NEC's [dual-speed CD-ROM] drives are pricey, but then so is time. Given that, the drive might save you 15 seconds a day—that's 90 hours in a year, if you use the drive every day."
—*PC SOURCES*, OCTOBER, 1992
(It would save you 91 minutes 15 seconds.)

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Winners this issue: Juan Carlos Cevellera (72 MHz), Jon LeVitre (Canon), James B. Reidy, Jr. (millisecond), Christopher Barr (Pentium), Peter Hays (Windows Performa), Edy Kusnadi (90 hours in a year).

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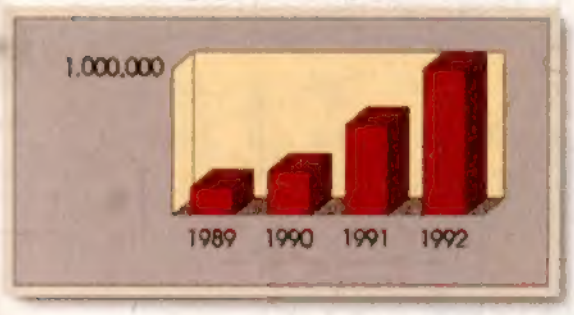

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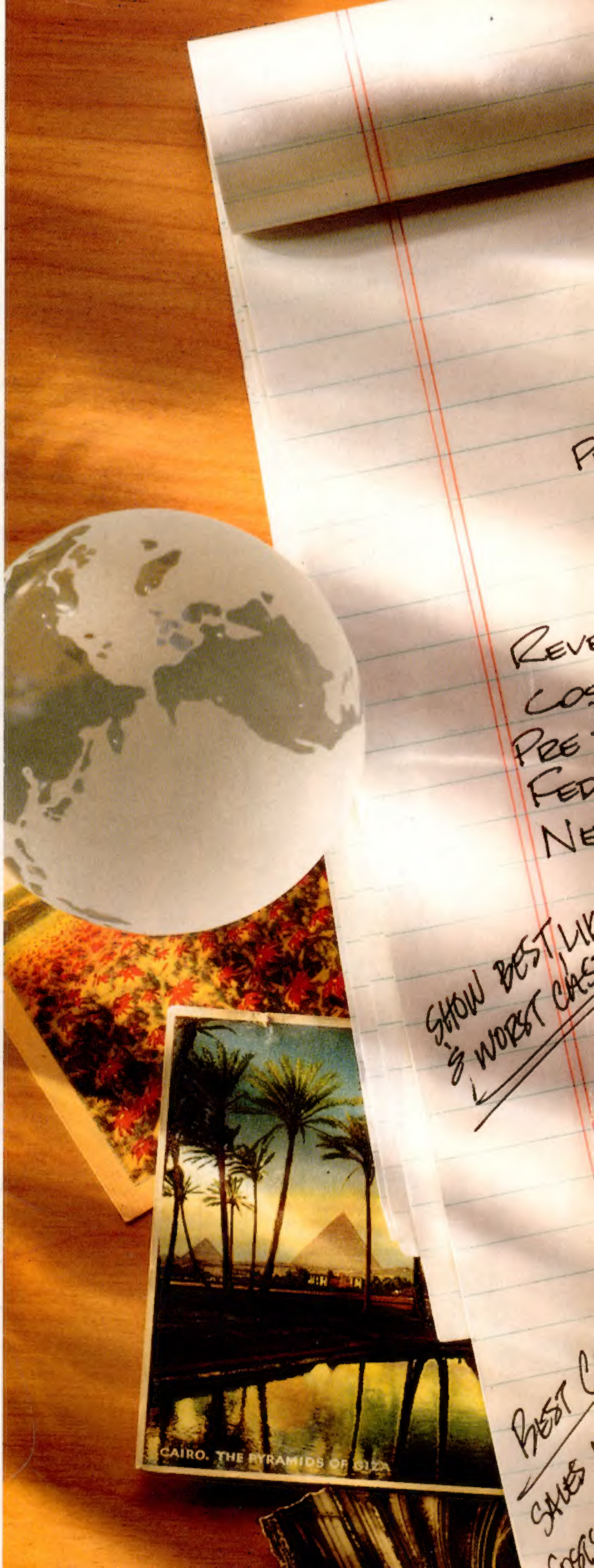
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